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EXPERIMENT STATION

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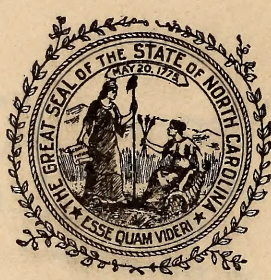
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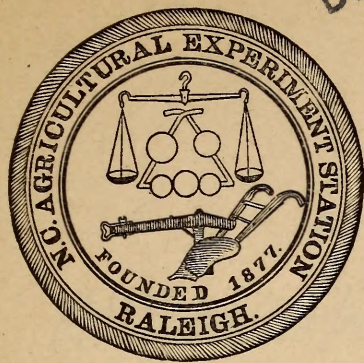
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Eleventh Annual Report

OF THE

North Carolina

Agricultural Experiment Station

For the Year 1888

NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION,
AND STATE WEATHER SERVICE,

UNDER THE CONTROL OF THE
STATE BOARD OF AGRICULTURE.

Gov. ALFRED M. SCALES (*Ex officio*), CHAIRMAN.

W. R. WILLIAMS, ESQ.....Master State Grange Patrons of Husbandry.
COL. R. W. WHARTON.....First Congressional District.
DR. A. G. BROOKS.....Second Congressional District.
MAJ. H. L. GRANT.....Third Congressional District.
COL. W. F. GREEN.....Fourth Congressional District.
J. S. MURROW, ESQ.....Fifth Congressional District.
CAPT. S. B. ALEXANDER.....Sixth Congressional District.
A. LEAZAR, ESQ.....Seventh Congressional District.
BURWELL BLANTON, ESQ.....Eighth Congressional District.
DR. C. D. SMITH.....Ninth Congressional District.

EXECUTIVE COMMITTEE:

Gov. A. M. SCALES, COL. W. F. GREEN, CAPT. S. B. ALEXANDER.

FINANCE COMMITTEE:

A. LEAZAR, W. R. WILLIAMS, H. L. GRANT.

RALEIGH, N. C.

NORTH CAROLINA

Agricultural Experiment and Fertilizer Control Station,

RALEIGH, N. C.

OFFICERS:

H. B. BATTLE, PH. D., Director and State Chemist.

J. R. CHAMBERLAIN, B. S.....	Agriculturist.
F. B. DANCY, A. B.....	Assistant Chemist.
R. G. GRISSOM, B. S. (Resigned September, 1888).....	Assistant Chemist.
W. A. WITHERS, A. M. (Resigned October, 1888).....	Assistant Chemist.
F. B. CARPENTER, B. S.	Assistant Chemist.
B. THORP, B. S.....	Assistant Chemist.
J. R. HARRIS	Assistant Chemist.
GERALD McCARTHY, B. Sc.....	Botanist.
H. McP. BALDWIN (U. S. Signal Corps).....	Meteorologist.
R. T. BURWELL, PH. B.....	Secretary.

LABORATORY AND OFFICES, CORNER OF EDENTON AND HALIFAX STREETS,
RALEIGH; FARM, PLANT HOUSE, EXPERIMENTAL BARN AND
DAIRY, 1½ MILES WEST ON THE HILLSBORO ROAD.

The Experiment Station, by legislative enactment of 1887, receives the benefit
of all funds derived from the U. S. Hatch Act; the scope of work
is thereby largely increased.

VISITORS CORDIALLY INVITED AND ALWAYS WELCOMED.

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THE NORTH CAROLINA
Agricultural Experiment and Fertilizer Control Station.

ESTABLISHED IN 1877.

HAS FOR ITS SCOPE:

I. Chemical and Microscopical Work, including

1. The analysis of all fertilizers legally on sale in the State.
2. The analysis of agricultural chemicals, of composts, and home-made fertilizers, and all materials from which they can be made.
3. The analysis of soils, marls and mucks.
4. The analysis of feeding stuffs.
5. The examination of seeds with reference to their purity, and capacity to germinate.
6. The examination of grasses and weeds
7. The study of insects injurious to vegetation.
8. The analysis of milk, butter and other dairy products.
9. Such other chemical and microscopical investigation as is demanded in the experimental work of the Station.

II. Experimental Work in the Field, Stable, and Laboratory, to include

1. The effect of different fertilizers on various soils of the State.
2. The study of improved methods for cultivation of the staple crops.
3. The study of the best treatment for worn-out lands.
4. The study of the best system for the rotation of crops.
5. Chemical investigations, with practical experiments with cattle, on the value of the various forage crops.
6. Investigations on the growth of new crops for this climate, in comparison with those we now have.
7. The construction of the silo, and value of ensilage.
8. The study of the growth of cattle using the different feeding stuffs.
9. Investigations in the production of milk and butter under different conditions, and with various implements.
10. Digestion experiments with stock, to ascertain the value of various food stuffs.
11. Experiment with the various feeding rations to ascertain how far the feeding standards can be relied on.
12. Such other work from time to time as may be deemed advisable for the interests of the agriculture of the State.

III. The Collection and Distribution of Meteorological Data, such as will directly aid the various agricultural industries of the State. The work is expected to be of benefit in

1. A foreknowledge of the coming of cold waves, protecting fruit and tobacco interests.
2. A foreknowledge of the coming of frosts, to benefit the same industries.
3. The distribution to various portions of the State of telegrams giving the probable state of the weather for the succeeding 24 hours.
4. The collection of various meteorological data, and by obtaining a more perfect idea of the various climatic changes, to extend to other localities the crops found useful in portions of this and other States.
5. The collection and distribution of reports showing the effect of the weather on the crops during successive periods of their growth.

IV. A Bureau of Information for all subjects connected with the agricultural industries of the State. Information of this character is always given as promptly and carefully as possible.

V. Miscellaneous Samples. Samples, when sent by citizens of the State, for chemical examination, will be analyzed free of charge—

1. If the experimental work of the Station will not seriously be retarded thereby.
2. If they are of sufficient public interest and the Station is free to publish the results.
3. If the samples are taken and sent according to the Station's printed forms, and are fully described.

VISITORS will be gladly welcomed at

1. Offices, laboratories, and weather station, in the Agricultural Building, one block north of the State Capitol.
2. Farm, experimental stables and dairy, and plant house, on the Hillsboro road, 1½ miles west of the State Capitol, and adjoining the grounds of the State Agricultural Society and of the Agricultural and Mechanical College.

Both the laboratories and the farm have telephonic communication.

Publications will be sent to any address upon application.

Address

Dr. H. B. BATTLE, Director, Raleigh, N. C.

PUBLICATIONS
OF THE
NORTH CAROLINA EXPERIMENT STATION,
1878 to 1889.

This list includes reports and special publications, but excludes all circulars, directions and forms. The Station has been regularly represented by articles in the *Monthly Bulletin* of the Department of Agriculture previous to June, 1888, at which time separate bulletins of the Experiment Station were begun to be published as is required by the U. S. Hatch Law. Unless marked otherwise, they are unbound. Except some of the Annual Reports, all these publications before 1888 are out of print and cannot be supplied.

The following were issued under the Directorship of Dr. Albert R. Ledoux:

- Directions for Making Vinegar, 1878, 4 pages;
- Analyses and Valuations of Fertilizers, 1877-'78, 30 pages;
- Ville's formulæ for composting, and others furnished by Dr. Ledoux, 1878, 16 pages;
- The Sugar Beet in North Carolina, 1878, 50 pages;
- Silica vs. Ammonia, results of comparative soil-tests of Popplein's Silicated Phosphate, with a number of ammoniated guanos, 1878, 24 pages;
- Analyses and Valuations of Fertilizers for 1877 and 1878, republished, 1879, 16 pages;
- Report of the Director to the Legislature, January, 1879, Document No. 8, 16 pages;
- Analyses and Valuations of Fertilizers for 1879, 8 pages;
- Formulæ for Composting, 1879, 16 pages;
- Report of the Station for 1879 (bound), 193 pages;
- Report of the Station for 1880, including Analyses of Fertilizers for that year (bound), 148 pages.

The following were issued under the Directorship of Dr. Charles W. Dabney, Jr.:

- Report to the Legislature, January, 1881, 16 pages;
- Analyses of Drinking Waters, Bulletin for January, 1881;
- Value of Active Ingredients of Fertilizers, Bulletin for February, 1881;
- The Use of Agricultural Chemicals, Bulletin for March, 1881;
- Analyses and Valuations of Fertilizers and Chemicals, 1881, 16 pages;
- Adulterated Chemicals, Bulletin for July, 1881;
- Analyses and Valuations of Fertilizers, 2d edition, 1881, 12 pages;
- Report of the Station for 1881 (bound), 172 pages;
- Trade in Fertilizers—Extension in Cotton Culture, Bulletin for January, 1882;
- Home-made Manures—High-manuring on Cotton, Bulletin for February, 1882;
- Does Cotton Exhaust? Cotton Seed and its Uses, Bulletin for March, 1882;

Stable Manure Saved and Composted—Rice Products as a Feeding-stuff, Bulletin for April, 1882;

Analyses of Fertilizers, 1882, 8 pages;

Analyses of Fertilizers, 2d edition, 1882, 12 pages;

Experience with Home-made Manures, Bulletin for June, 1882;

Report of Work done for the State Board of Health, 1881, 8 pages;

Treatment of Cotton Lands—Station at State Fair, Bulletin for October, 1882;

Report of the Station, 1882 (bound), 152 pages;

Horn, Leather and Wool-Waste, and the Fertilizers made from them, 1882, 10 pages;

Finely-ground Phosphates or "Floats," 1882, 10 pages;

On Kainite, 1882, 28 pages;

Rice and its Products—Food and Fodder Plants, Bulletin, May, 1882;

The Soja Bean—Waste Products of Tobacco Factories, Bulletin, May, 1883;

Analyses of Fertilizers, 1883, 16 pages;

Analyses of Fertilizers, 2d edition, 1883, 16 pages;

Cotton Seed and its Products, Bulletin, June, 1883;

N. C. Resources for Commercial Fertilizers,

I. Ammoniates;

II. Potash Sources, Bulletin, December, 1883;

III. Phosphates, Bulletin, January, 1884;

The Trade in Fertilizers during 1883, 12 pages;

Cost of the Ingredients of Fertilizers, Bulletin, February, 1884;

The Phosphate Investigation, Bulletin, March, 1884;

Analyses of Fertilizers, season of 1884, 16 pages;

Composition of North Carolina Phosphates, Bulletin, April, 1884;

North Carolina Phosphates, report on, 26 pages;

Report of Station, 1883 (bound), 104 pages;

Analyses of Fertilizers, season of 1885, 16 pages;

Analyses of Fertilizers, 2d edition;

Report of Station, 1884 (bound), 104 pages;

Analyses of Fertilizers, additional, Fall, 1885, a circular, 2 pages;

Analyses of Composts, etc., a Bulletin, 2 pages;

Injurious Insects and Diseases of Stock, a Bulletin, 2 pages;

Report of Station, 1885 (bound), 112 pages, 3 charts,

Instructions for Voluntary Observers and Displaymen, 24 pages;

Report of Station, 1886 (bound), 130 pages, 3 plates.

The following were issued under the Directorship of Dr. H. B. Battle:

Formulæ for Composts, September, 1887, 4 pages;

Report of N. C. Weather Service for 1887, 37 pages;

Composts and Ingredients Composing Them, 24 pages;

Report of Experiment Station for 1887 (bound), 225 pages, 1 chart, 2 plates.

Experiment Station BULLETIN No 57, June, 8 pages:

Article I. Field Experiments.

Article II. Special Notice.

Experiment Station BULLETIN No. 58, July, 16 pages:

Article III. Details of Field Experiments.

Article IV. Examination of N. C. Drinking Waters.

Article V. Meteorological Summary for June.

Article VI. Important Announcement.

Experiment Station BULLETIN No. 59, August and September, 12 pages:

Article VII. Purity and Vitality of Seed, with tests of Seed sold in North Carolina.

Article VIII. Meteorological Summary for July-August.

Experiment Station BULLETIN No. 60, October-November, 16 pages:

Article IX. Lucerne, its Value as a Forage Crop.

Article X. Meteorological Summary for September-October.

Experiment Station BULLETIN No. 61, December, 32 pages:

Article XI. Composts, Formulas, Analyses and Value.

Report of the N. C. State Weather Service for 1888, 27 pages.

Report of the Experiment Station for 1888 (bound), 154 pages.

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ELEVENTH ANNUAL REPORT
OF THE
DIRECTOR
OF THE
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION,
FOR THE YEAR 1888.

The State of North Carolina was one of the early pioneers in the establishment of an Agricultural Experiment Station. The Station thus established on the 12th of March, 1877, was the *first* in the Southern States, and the *second* in America. It is accordingly now entering on the 13th year of its existence.

The objects for which the establishment of such a Station was desired at that time were twofold:

1st. To protect the farmers of the State from the fraudulent fertilizers then flooding the market, and by a judicious control of their sale through analyses of the various brands, to maintain their guaranteed grade.

2d. To carry on experiments in the field (in the language of the act) "on the nutrition and growth of plants with a view to ascertain what fertilizers are best suited to the various crops of this State, and whether other crops may not be advantageously grown on its soil."

In addition to what was designed, the Station has not only faithfully endeavored to carry out these general plans, but has been as well a bureau of information on all subjects pertaining to agriculture, where farmers and others have sought information in regard to farming or any of its allied branches. Where seeds, marls, soils, composts or any fertilizing ingredients have been examined and their quality determined. Where feeding stuffs have been analyzed and their value ascertained. Where insects injurious to vegetation have been studied, and remedies recommended. Where varieties of cultivated plants have been tested. Where seeds have been examined with reference to their purity and capacity to germinate. Where farmers have obtained special information on subjects which, by reason of their limited libraries, they could not obtain for themselves.

During this time the Station was sustained wholly by appropriations from the State with varying amounts. Owing to decreased appropria-

tions brought about by legislative enactments of the session of 1887 of the General Assembly, the operations of the Station were materially lessened during that year. Consequent upon this reduction of funds a reduction of force and a cessation of some important experimental work, notably, at the farm, in conjunction with the other branches of the Station, became necessary. At the end of the season of 1887 the entire farm work had to be abandoned and the operations there discontinued.

Fortunately, at this juncture, the now famous Hatch Act was passed by the Congress of the United States, which appropriates to each State and Territory \$15,000 per annum for the purpose of establishing and maintaining an Agricultural Experiment Station for the sole purpose of conducting researches and verifying experiments, etc., in accordance with the specified requirements. Subsequent to the passage of this act the Legislature of this State accepted the conditions of the Hatch Act and appropriated the whole of the funds to be derived therefrom to the maintenance of this Experiment Station. For a long time, however, it was considered doubtful by the Treasury authorities at Washington whether the appropriation was actually made to carry into effect the provisions of the law. This doubt so continued until the succeeding Congress solved the difficulty by passing a direct appropriation from the Treasury for the object as set forth. So late, however, was this that the Station did not receive any of the funds until far in the spring of 1888, too late to accomplish anything in the way of experimental field work for that season. The Congressional appropriations from the United States, though not received until March and April of 1888, really covered the time from July 1, 1887, and part of the funds thus received from the United States were consequently applied to the payment of the expenditures of the Station from this time (July 1, 1887). The Experiment Station now receives its support wholly from this source, with the exception of a small amount appropriated by the Board of Agriculture for the purpose of carrying on chemical work required by the laws of the State, and not allowed by the provision of the Hatch Act.

THE HATCH ACT.

The full text of the Hatch Act of the Congress of the United States is given below, for the purpose of distributing more widely a knowledge of what may be considered, by all odds, the crowning donation up to this time of the United States, for the upbuilding and uplifting of the nation's agriculture, through the means of pure agricultural research and experimentation.

AN ACT to establish agricultural experiment stations in connection with the colleges established in the several States under the provisions of an act approved July second, eighteen hundred and sixty-two, and of the acts supplementary thereto.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That in order to aid in acquiring and diffusing among the people of the United States useful and practical information on subjects connected with agri-

culture, and to promote scientific investigation and experiment respecting the principles and applications of agricultural science, there shall be established, under direction of the college or colleges or agricultural departments of colleges in each State or Territory established, or which may hereafter be established in accordance with the provisions of an act approved July second, eighteen hundred and sixty-two, entitled "An act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," or any of the supplements to said act, a department to be known and designated as an "agricultural experiment station; *Provided*, That in any State or Territory in which two such colleges have been or may be so established the appropriation hereinafter made to such State or Territory shall be equally divided between such colleges, unless the legislature of such State or Territory shall otherwise direct.

SEC. 2. That it shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals; the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of foods for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective States or Territories.

SEC. 3. That in order to secure, as far as practicable, uniformity of methods and results in the work of said stations, it shall be the duty of the United States Commissioner of Agriculture to furnish forms, as far as practicable, for the tabulation of results of investigation or experiments; to indicate, from time to time, such lines of inquiry as to him shall seem most important; and, in general, to furnish such advice and assistance as will best promote the purposes of this act. It shall be the duty of each of said stations, annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located a full and detailed report of its operations, including a statement of receipts and expenditures, a copy of which report shall be sent to each of said stations, to the said Commissioner of Agriculture, and to the Secretary of the Treasury of the United States.

SEC. 4. That bulletins or reports of progress shall be published at said stations at least once in three months, one copy of which shall be sent to each newspaper in the States or Territories in which they are respectively located, and to such individuals actually engaged in farming, as may request the same, and as far as the means of the station will permit. Such bulletins or reports and the annual reports of said stations shall be transmitted in the mails of the United States free of charge for postage, under such regulations as the Postmaster-General may from time to time prescribe.

SEC. 5. That for the purpose of paying the necessary expenses of conducting investigations and experiments and printing and distributing the results as hereinbefore prescribed, the sum of fifteen thousand dollars per annum is hereby appropriated to each State, to be specially provided for by Congress in the appropriations from year to year, and to each Territory entitled under the provisions of section 8 of this act, out of any money in the Treasury proceeding from the sales of public lands, to be paid in equal quarterly payments, on the first day of January, April, July, and October in each year, to the treasurer or other officer duly appointed by the governing boards of said colleges to receive the same, the first payment to be made on the first day of October, eighteen hundred and eighty-seven; *Provided, however*, That out of the first annual appropriation so received by any station an amount not exceeding one-fifth may be expended in the erection, enlargement, or repair of a building or buildings necessary for carrying on the work of such station; and thereafter an amount not exceeding five per centum of such annual appropriation may be so expended.

SEC. 6. That whenever it shall appear to the Secretary of the Treasury from the annual statement of receipts and expenditures of any of said stations that a portion of the preceding annual appropriation remains unexpended such amount shall be deducted from the next succeeding annual appropriation to such station, in order that the amount

of money appropriated to any station shall not exceed the amount actually and necessarily required for its maintenance and support.

SEC. 7. That nothing in this act shall be constructed to impair or modify the legal relation existing between any of the said colleges and the government of the States or Territories in which they are respectively located.

SEC. 8. That in States having colleges entitled under this section to the benefits of this act, and having also agricultural experiment stations established by law separate from said colleges, such States shall be authorized to apply such benefits to experiments at stations so established by such States, and in case any State shall have established under the provisions of said act of July second aforesaid, an agricultural department or experimental station, in connection with any university college or institution not distinctively an agricultural college or school, and such State shall have established or shall hereafter establish a separate agricultural college or school, which shall have connected therewith an experimental farm or station, the legislature of such State may apply in whole or in part the appropriation by this act made, to such separate agricultural college or school, and no legislature shall by contract express or implied disable itself from so doing.

SEC. 9. That the grants of moneys authorized by this act are made subject to the legislative assent of the several States and Territories to the purposes of said grants; *Provided*, That payment of such installments of the appropriation herein made as shall become due to any State before the adjournment of the regular session of its legislature meeting next after the passage of this act, shall be made upon the assent of the Governor thereof duly certified to the Secretary of the Treasury.

SEC. 10. Nothing in this act shall be held or construed as binding the United States to continue any payment from the treasury to any or all the States or institutions mentioned in this act, but Congress may at any time amend, suspend or repeal any or all the provisions of this act. Approved March 2, 1887.

STATE LAWS ACCEPTING THE HATCH FUND FOR MAINTENANCE OF THIS EXPERIMENT STATION.

The State of North Carolina in the following extracts of laws passed by the General Assembly, session of 1887, accepts the fund derived from the Hatch Act and appropriates it for the exclusive use of this Experiment Station.

[Chapter 409, Laws of North Carolina, Session of 1887.]

AN ACT to amend chapter one, volume two, of The Code, pertaining to Agriculture and Geology.

* * * SEC. 7. That section 2196 of The Code shall be amended by adding at the close thereof the words "and all the grants of money which may be made to this State by an act of Congress of the United States, entitled 'An Act to establish experiment stations,' etc., are hereby accepted on behalf of this State, and the same shall be devoted, under the direction of the board of agriculture, to the maintenance of the aforesaid agricultural experiment station under the laws of the United States and this State.

SEC. 17. This act shall be in force from and after its ratification.

In the General Assembly read three times, and ratified this the 7th day of March, A. D. 1887.

[Chapter 410, Laws of North Carolina, Session of 1887.]

AN ACT supplemental to chapter three hundred and eight, laws of eighteen hundred and eighty five, entitled "An Act to establish and maintain an industrial school."

* * * SEC. 6. * * * The said Board of Agriculture shall have power to accept on behalf of this State donations of property, real or personal, and any appropriations which may be made by the Congress of the United States to the several States and Territories for the benefit of agricultural experiment stations, and they shall expend the whole amount so received for the benefit of the aforesaid agricultural experiment station and in accordance with the act or acts of Congress in relation thereto.

* * * SEC. 11. This act shall be in force from and after its ratification.

In the General Assembly read three times, and ratified this the 7th day of March, A. D. 1887.

SCOPE OF WORK.

Since the Station began to receive the benefits of the Hatch Fund from the United States the scope of its work has been largely increased. It now includes

I. Chemical and Microscopical Work, including

1. The analysis of all fertilizers legally on sale in the State.
2. The analysis of agricultural chemicals, of composts, and home-made fertilizers, and all materials from which they can be made.
3. The analysis of soils, marls and mucks.
4. The analysis of feeding stuffs.
5. The analysis of potable and mineral waters.
6. The examination of seeds with reference to their purity, and capacity to germinate.
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8. The study of insects injurious to vegetation.
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1. The effect of different fertilizers on various soils of the State.
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4. The study of the best system for the rotation of crops.
5. Chemical investigations, with practical experiments with cattle, on the value of the various forage crops.
6. Investigations on the growth of new crops for this climate, in comparison with those we now have.
7. The construction of the silo, and value of ensilage.
8. The study of the growth of cattle using the different feeding stuffs.
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11. Experiments with the various feeding rations to ascertain how far the feeding standards can be relied on.
12. Such other work from time to time as may be deemed advisable for the interests of the agriculture of the State.

III. The Collection and Distribution of Meteorological Data, such as will directly aid the various agricultural industries of the State. The work is expected to be of benefit in

1. A foreknowledge of the coming of cold waves, protecting fruit and tobacco interests.
2. A foreknowledge of the coming of frosts, to be of benefit in the same way.
3. The distribution of telegrams of weather indications transmitted to various portions of the State.

4. The collection of various meteorological data; by obtaining a more perfect idea of the various climatic changes, to extend to other localities the crops found useful in portions of this and other States.

5. The collection and distribution of reports showing the effect of the weather on the crops during successive periods of their growth.

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1. If the experimental work of the Station will not seriously be retarded thereby.

2. If they are of sufficient public interest and the Station is free to publish the results.

3. If the samples are taken and sent according to the Station's printed forms, and are fully described.

GENERAL EQUIPMENT.

The headquarters of the Experiment Station are in the north wing of the Agricultural Building, immediately north of the Capitol, where are situated the various offices, laboratories, furnace-rooms, etc., botanical-room and weather station. Each of these rooms is well equipped with the various facilities necessary for carrying on the different portions of the work. On the roof of the building are located the various instruments for recording meteorological observations, also a 36-foot iron flag-staff for displaying the signals for the weather indications.

The experimental farm, on which are the experimental stables, dairy and plant-house, is situated just $1\frac{1}{2}$ miles west of the city limits and adjoining the grounds of the State Agricultural Society. The buildings for the experimental work with cattle and their products have been under construction for some months past, and are fast approaching completion. Active experimental work has not yet been begun in these new directions. When finished, the necessary equipment of stock, implements, &c., will be arranged and no time will be lost in beginning operations.

To each and all of these places visitors are cordially invited, and will be gladly welcomed.

RECORD OF WORK DURING 1888.

Some of the branches of the Station were added late in the season of 1888, notably in the case of the botanical work and the feeding and dairy experiments. The record for these branches, therefore, is short, much of the time having been consumed in necessary preparations and procuring buildings. In the feeding and dairy experiments especially, being new to this State, and hitherto with us untried, progress was necessarily slow.

The record of work for the year embraces:

- I. INFORMATION GIVEN.
- II. PUBLICATIONS.
- III. CHEMICAL WORK, including *a. Fertilizer Control*; *b. Experimental*; *c. Miscellaneous*.
- IV. COÖPERATIVE FIELD EXPERIMENTS.
- V. METEOROLOGICAL WORK.
- VI. ENTOMOLOGICAL WORK.
- VII. EXPERIMENTAL FARM WORK, including *a. Field Experiments*; *b. Feeding Experiments*; *c. Dairy Experiments*.
- VIII. BOTANICAL WORK.

I. INFORMATION GIVEN.

The letters constantly received by the Station show that information is asked for on almost every conceivable subject pertaining to the agriculture and to the development of North Carolina. Information of this character is given as carefully and fully as possible, and, above all, as promptly as possible. Any information which cannot be supplied by the Station through any of its officers, is procured from the best available source.

Judging from our correspondence our farmers are awakening to the importance of home-making and home-saving, diversification of crops and products of the soil, in cattle raising and in dairy production.

II. PUBLICATIONS.

As a rule, publications are embraced in reports and bulletins of the stations, though occasionally separate pamphlets are issued. The following is a list for the year 1888:

	<i>Number Issued.</i>
Report of North Carolina Weather Service for 1887, 37 pages,	500
Composts and Ingredients Composing them, 24 pages,	1,000
Report of Station for 1887, 225 pages,	6,500
Experiment Station BULLETIN No. 57, June,	7,680
Article I. Field Experiment.	
Article II. Special Notice.	
Experiment Station BULLETIN No. 58, July	7,680
Article III. Details of Field Experiments.	
Article IV. Examination of N. C. Drinking Waters.	
Article V. Meteorological Summary for June.	
Article VI. Important Announcement.	
Experiment Station BULLETIN No. 59, August and September,	7,680
Article VII. Purity and Vitality of Seed, with Tests of Seed sold in North Carolina.	
Article VIII. Meteorological Summary for July—August,	

	<i>Number Issued.</i>
Experiment Station BULLETIN No. 60, October—November,	7,680
Article IX. Lucerne, its Value as a Forage Crop.	
Article X. Meteorological Summary for September—October.	
Experiment Station BULLETIN No. 61, December,	7,680
Article XI. Composts, Formulas, Analyses and Value.	

Previous to July, 1888, articles contributed by the Station were inserted in the columns of *The Bulletin* of the Department of Agriculture, but since that time a separate bulletin of the Station is published in accordance with the requirements of the Hatch act.

The following, reprinted from the introductory article of BULLETIN No. 57, the first to be published after the separate issue was commenced, will explain the general scope of these articles:

“This series of reports of progress of the Experiment Station are in the main intended for the people of North Carolina, and clearness of style, plainness of statement and freedom from technicality is rather to be sought after than purely scientific and theoretical discussions which would interest only those of scientific training. For this purpose well-known facts and statements which may be superfluous to the scientific reader, we will feel at perfect liberty to insert in any part of these reports, knowing that the principles of agriculture and experimental research cannot be too often repeated; for these principles will probably be serviceable to those who have been familiar with them in the past and have overlooked them for the time being, as well as to the other number who read them for the first time.”

It will be seen, therefore, that practical matters, more especially such as is designed to directly aid the farmer, will be inserted in the bulletins. For this purpose we will not hesitate to include matter not original, for the purpose of educating and instructing. The original investigations, as well as the record of such work as it is desirable to have, will in addition be permanently preserved in the annual reports.

A slight departure in the manner of preparing the annual reports is thus inaugurated, and probably should be distinctly referred to a second time. The reports will only contain original and new matter in addition to a full record of the routine work, as well as such work as the analyses of licensed fertilizers, etc., which should be permanently preserved. Formulas for composts and the like, which will thus be excluded from the annual reports, will be included in full in separate bulletins. A supply of the bulletins on special subjects are preserved and will be mailed to those applying for them.

All publications are mailed free to any address in the State, upon application. To receive the bulletins as they are issued, only one application is necessary; but to receive the annual reports, persons must apply each year, after timely notice is given.

III. CHEMICAL WORK.

Occupying the larger portion of the time and attention of the Station, the chemical work ranks first among its many agencies. A principal feature of the laboratory work is

a. *The Fertilizer Control*.—As one of the objects designed for the Experiment Station by the statutes of 1877, this branch of our work still receives much consideration. It demands special space for treatment in this report.

LAWS IN REGARD TO THE EXPERIMENT STATION AND THE CONTROL OF FERTILIZERS.

The following extracts from The Code of North Carolina, adopted in 1883, contains the sections pertaining to this subject, as modified by subsequent General Assemblies, which are now in force. These extracts embody all the existing laws of the State of North Carolina now (1889) in relation to the N. C. Experiment Station and the Fertilizer Control as exercised by the Experiment Station :

Sec. 2190. Tax on fertilizers; seizure, &c., of fertilizers offered for sale without license. 1876-'7, ch. 274, sec. 8; 1876-'7, ch. 291; 1881, ch. 118.

No manipulated guanos, superphosphate or other commercial fertilizer shall be sold or offered for sale in this State until the manufacturer or person importing the same shall first obtain a license therefor from the Treasurer of the State, for which shall be paid a privilege tax of five hundred dollars per annum, for each separate brand or quality. Any person, corporation or company who shall violate this chapter, or who shall sell or offer for sale any such fertilizer contrary to the provisions above set forth, shall be guilty of a misdemeanor. And all fertilizers sold, or offered for sale, shall be subject to seizure and condemnation in the same manner as is provided in this chapter for the seizure and condemnation of spurious fertilizers, subject, however, to the discretion of the Board of Agriculture to release the fertilizers so seized and condemned, upon the payment of the license tax, and all costs and expenses incurred by the Department in such proceeding.

State v. Norris, 73—443.

Sec. 2191. Packages to be labeled; copy of label to be filed with the Commissioner at or before shipment into the State, &c. 1876-'7, ch. 274, sec. 9; 1887, ch. 409, sec. 6.

Every bag, barrel or other package of such fertilizer as above designated, offered for sale in this State, shall have thereon plainly printed a label or stamp, a copy of which shall be filed with the Commissioner of Agriculture, together with a true and faithful sample of the fertilizer which it is proposed to sell, at or before the shipment of such fertilizer

into this State, and which will be uniformly used, and shall not be changed during the year for which the license is issued; and the said label or stamp shall truly set forth the name, location and trade-mark of the manufacturer; also the chemical composition of the contents of such package, and the real percentage of any of the following ingredients asserted to be present, to-wit: Soluble and precipitated phosphoric acid, soluble potassa, ammonia or its equivalent in nitrogen, together with the date of its analyzation, and that the privilege tax has been paid; and any such fertilizer as shall be ascertained by analysis not to contain the ingredients and percentage set forth as above provided shall be liable to seizure and condemnation as hereinafter prescribed, and when condemned shall be sold by the Board of Agriculture for the exclusive use and benefit of the Department of Agriculture.

Sec. 2192. Proceedings to condemn fertilizers to be by civil action, &c.; affidavit; clerk to issue order of seizure; duty of sheriff; bond of defendant; judgment. 1881, ch. 118.

The proceedings to condemn the same shall be by civil action in the Superior Court of the county where the fertilizer is on sale, and in the name of the Board of Agriculture, who shall not be required to give bond for the prosecution of said action. And at or before the summons is issued the said Board shall, by its agent, make affidavit before the clerk of said court of these facts:

(1). That a license has been obtained for the sale of a fertilizer of a particular brand.

(2). That samples of the same have been analyzed under the authority of the Board, and found to correspond with the label attached to the same.

(3). That the defendant in the summons has in his possession, and on sale, fertilizers of the same name and brand, and bearing a label or stamp representing the analysis made.

(4). That the fertilizers on hand and on sale are spurious and do not in fact contain the ingredients or in the proportion represented by the stamp or label on them. Whereupon the clerk shall issue his order to the sheriff of the county to seize and hold all fertilizers in the possession of the defendant labeled or stamped as the affidavit described. And the sheriff shall seize and hold the fertilizers so seized until ordered to be surrendered by the judge; unless the defendant shall give bond with justified surety, in double the value of the fertilizers seized, to answer the judgment of the court, in which case he shall surrender the fertilizers to the defendant and file this bond in the office of the clerk of the Superior Court, and thereafter the action shall be prosecuted according to the course of the court. And if it shall be established in the trial that the fertilizers seized are deficient, or inferior to the analysis represented on the stamp or brand, then the plaintiff in said action shall recover judgment on the defendant's bond for the value of the fertilizers seized.

Sec. 2193. Any merchant selling any commercial fertilizer without label or stamps attached liable to a fine of ten dollars, to be collected by the sheriff; any person offering for sale condemned fertilizers guilty of a misdemeanor. 1876-'7, ch. 274, sec. 9.

Any merchant, trader, manufacturer or agent who shall sell or offer for sale any commercial fertilizer without having such labels and stamps, as hereinbefore provided, attached thereto, shall be liable to a fine of ten dollars for each separate bag, barrel or package sold or offered for sale, to be sued for before any justice of the peace, and to be collected by the sheriff, by distress or otherwise, one-half, less the cost, to go to the party suing and the remaining half to the department; and if any such fertilizer shall be condemned, as herein provided, it shall be the duty of the department to have an analysis made of the same, and cause printed tags or labels, expressing the true chemical ingredients of the same, put upon each bag, barrel or package, and shall fix the commercial value thereof at which it may be sold. And any person who shall sell or offer for sale any such fertilizer, in violation of this section, shall be guilty of a misdemeanor.

Sec. 2194. Power of the department. 1876-'7, ch. 274, sec. 10.

The Department of Agriculture shall have power and authority, at all times, to have collected samples of any commercial fertilizer offered for sale in this State, and have the same analyzed, and such samples shall be taken from at least ten *per centum* of the lot from which they may be selected.

Sec. 2195. Agents of railroad and steamboat companies to furnish monthly statements of the quantity of fertilizers transported by them; on failure to do so, guilty of a misdemeanor. 1876-'7, ch. 274, sec. 11.

It shall be lawful for the Department of Agriculture to require the officers, agents or managers of any railroad or steamboat company, transporting fertilizers in this State, to furnish monthly statements of the quantity of fertilizers, with the name of the consignor or consignee, delivered on their respective lines, at any and all points within this State. And said department is hereby empowered to compel said officers, agents or managers to submit their books for examination, if found expedient so to do; and any such agents, officers or managers failing or refusing to comply shall be guilty of a misdemeanor.

Sec. 2196. Establishment of an Agricultural Experiment and Fertilizer Control Station; duties of the Chemist. 1876-'7, ch. 174, sec. 12; 1879, ch. 175; 1881, ch. 373, sec. 4; 1887, ch. 409, sec. 7.

The Department of Agriculture shall establish an Agricultural Experiment and Fertilizer Control Station, and shall employ an analyst skilled in agricultural chemistry. It shall be the duty of the said chemist to analyze such fertilizers and products as may be required by the Department of Agriculture, and to aid as far as practicable in suppressing fraud in the sale of commercial fertilizers. He shall also, under the direction of said department, carry on experiments on the nutrition

and growth of plants, with a view to ascertain what fertilizers are best suited to the various crops of this State; and whether other crops may not be advantageously grown on its soil, and shall carry on such other investigations as the said department may direct. He shall make regular reports to the said department of all analyses and experiments made, which shall be furnished, when deemed needful, to such newspapers as will publish the same. His salary shall be paid out of the funds of the Department of Agriculture, and all the grants of money which may be made to this State by an act of the Congress of the United States, entitled "An act to establish Experiment Stations," etc., are hereby accepted on behalf of this State, and the same shall be devoted, under the direction of the Board of Agriculture, to the maintenance of the aforesaid Agricultural Experiment Station, under the laws of the United States and this State.

Sec. 2204. Dealers in fertilizers authorized to sell surplus on hand not exceeding ten tons. 1883, ch. 291, sec. 7.

Any dealer in fertilizers who may have on hand a quantity not exceeding ten tons when the license for the year expires shall not be prevented from selling the same without further taxes.

Sec. 2205. Manufacturers liable to no other tax than five hundred dollars. 1883, ch. 291, sec. 8.

Whenever any manufacturer of fertilizers shall have paid the license tax of five hundred dollars, his goods shall not be liable to any further tax, whether by city, town or county.

THE FERTILIZER CONTROL.

SEASON OF 1888.

The objects of the Fertilizer Control, as exercised by the Experiment Station according to section 2196 of the State Code, are well known, namely: To protect the farmers of the State from fraudulent fertilizers by requiring every manufacturer doing business in the State to take out a license on each brand on sale by him; to exercise a general control of the trade by a system of inspecting all brands legally on sale in the State; and by a chemical analysis of these brands to ascertain if their qualities are maintained at a certain guaranteed standard.

As to whether the Experiment Station has fulfilled its mission in respect to the fertilizer control there can hardly be any doubt. We point with pride to the row in the Station's museum of fraudulent chemicals and worthless fertilizers detected and brought to light entirely through our efforts; and to the decrease in cost to the farmers of commercial fertilizers, and to the marked increase in quality as shown by the average composition of ammoniated fertilizers for the various years.

The great difficulty this year has been, as heretofore, in securing samples for analysis, and this is due not to any fault of the inspectors in not securing the samples, but to the lateness of time at which fertilizers are shipped into the State and offered for sale. The samples are all drawn from goods after they leave the manufacturers' hands, and consequently not until they are in the hands of local agents can samples be taken. The wisdom of this plan is manifest, since in this way is all possibility of securing an erroneous sample avoided. While it may throw the analyses a little late, yet even this is preferable to accepting samples sent by manufacturers to represent goods designed to reach the farmers.

DIGEST OF FERTILIZER LAWS IN FORCE IN NORTH CAROLINA.

In order to give a short and more concise statement of all laws now in operation in regard to the fertilizer inspection and control, the following carefully prepared digest of existing laws is inserted, as a guide to the fertilizer trade and for the information of the farmers. The full text of the fertilizer laws has already been inserted:

No manipulated guanos, superphosphate or other commercial fertilizers shall be sold or offered for sale until a license shall be issued by the State Treasurer.

This privilege tax of \$500 per annum is required for each separate brand or quality. The Department of Agriculture has power at all times to have samples collected of any fertilizer on sale, which must be taken from at least ten per cent. of the lot selected. These samples are taken from the goods in the hands of dealers after they are shipped from the manufactories, and accordingly represent the true grade of fertilizers offered for sale.

Every package of fertilizer offered for sale must have thereon a plainly printed label, a copy of which must be filed with the Commissioner of Agriculture, together with a true sample of the fertilizer which it is proposed to sell, at or before the shipment of such fertilizer into the State, and which label must be uniformly used and not changed during the year. This label must set forth the name, location and trade-mark of the manufacturer, also the chemical composition of contents, and percentage of the ordinary ingredients, together with date of analyzation, and that the tax has been paid.

By a recent ruling the variation in claims, which has been allowed for a number of years is now no longer accepted. The bags must be branded with the exact chemical composition of the contents. Licenses issued after this ruling will all conform to this plan.

Any fertilizer that is offered for sale without being licensed, or that is spurious and does not contain ingredients as represented by the label, is seized, and, after being established on trial, its value is recovered by the Board of Agriculture.

Any person who offers for sale a fertilizer without having attached thereto labels as provided by law is liable to a fine of \$10 for each separate package, one-half, less the cost, going to the party suing, and the remainder to the Department; and if such fertilizer is condemned the Department makes analysis of the same and has printed labels giving the true chemical ingredients of the same put on each package, and fixes the commercial value at which it may be sold.

The Department of Agriculture can require agents of railroad and steamboat companies to furnish monthly statements of the quantity of fertilizers transported by them.

The Director of the Experiment Station analyzes all fertilizers required, which are published when deemed needful.

In order to further define the term "commercial fertilizer," it was resolved by the Board of Agriculture, October 15th, 1879:

"That the following articles shall be admitted free of tax, with such additions or changes as may afterwards be made by the Executive Committee, upon consultation with the chemist, viz.: ground bone, bone ash, ground bone black, ground phosphate rock, or other mineral phosphate, nitrogenous organic matter commercially free from phosphoric acid and potash, nitrate of soda, nitrate of potash (saltpetre), sulphate of ammonia, muriate of ammonia, kainite, sulphate of magnesia, sulphate of potash, sulphate of soda, muriate of potash, lime, plaster, ground cracklings, ground tankage, salt, and oil of vitriol."

Upon the following articles the license tax will be exacted :

"Any of the above articles, or others, sold for fertilizing materials *under any trademark or proprietary brand*; upon dissolved bone, dissolved bone black, dissolved mineral phosphates (all acid phosphates or superphosphates), and upon any two or more of the articles mentioned in the first list, if combined either chemically or mechanically."

ANALYSES OF FERTILIZER SAMPLES FROM FARMERS.

All official analyses are made from samples taken by the authorized inspectors. These only are published and are sufficient as final evidence if the guaranteed claim is not maintained.

In any special cases where there appears to be a reason for doubting that the lot be not up to the guaranteed claim, the Experiment Station will analyze a sample of the same, provided it is taken strictly according to the instructions which are given below. The sampling must be witnessed by two additional persons, who must attest the same by their signatures. The sample must also be sealed in their presence.

N. C. EXPERIMENT STATION.

DIRECTIONS FOR SAMPLING FERTILIZERS.

The Station makes analyses for farmers of North Carolina without charge; provided the samples are taken according to these directions and proper form is completely filled up and certified to.

Samples, when accepted, will be entered upon our register in the order of their coming and analyzed in turn. The results of each analysis will be promptly communicated to the person sending the sample.

Fertilizers are sampled by the regular inspector for official analysis.

The valuation of a high priced fertilizer requires the amounts, or per cents. of its principal fertilizing elements to be known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The sub-joined directions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses moisture during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind or from keeping in a poorly closed vessel.

1. Provide a tea-cup, some large papers, and for the sample a glass fruit jar, or tin can or box, holding about one quart, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizers, and enter these actual weights in the "Form for Sending Fertilizer Samples."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if necessary, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly, but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, seal in the presence of witnesses, label plainly, and send, charges prepaid, to

THE N. C. AGRICULTURAL EXPERIMENT STATION,
Raleigh, N. C.

The following is a sample of the form which is supplied on application, in case it is desired to send a sample of commercial fertilizer to the Station. The fertilizer must be licensed for sale in the State. All of the form must be filled completely:

N. C. EXPERIMENT STATION.

FORM FOR SENDING FERTILIZER SAMPLES AND CHEMICALS.

This Form must be Filled up Completely or Sample may be Rejected.

NEVER SEND A SAMPLE GIVEN YOU BY A MANUFACTURER OR DEALER.

DATE OF TAKING SAMPLE.....188 ..

N. C. AGRICULTURAL STATION, RALEIGH, N. C.

SIR:—I send you to-day, marked....., contained in a....., a fair sample, drawn according to directions on opposite side of this sheet, of the following fertilizer:

Weight branded on each bag or package.....lbs.

Actual weight of one bag or package.....lbs.

Name of Fertilizer.....

Manufactured by.....

At.....

Purchased of or received from

At.....

Selling price per ton, bag or barrel, \$.....

Give the amounts of the following ingredients as branded on the bags:

Available (or soluble and reverted) phosphoric acid per cent.

Nitrogen (or ammonia), if claimed, - - - - - " "

Potash, if claimed, - - - - - " "

My reasons for supposing this fertilizer is below its guarantee are:

.....
.....
.....

Name,.....

Post-Office,.....

THIS CERTIFICATE MUST BE SIGNED BY TWO WITNESSES:

We hereby certify that we have witnessed the drawing of the above sample, that it is a fair one and taken according to the instructions on the opposite side of this sheet, that the above copy of names and figures is a correct one, and that it was sealed in our presence and delivered to the post-office or express company.

Name of Witness.....

Name of Witness.....

NO ANALYSES OF UNLICENSED BRANDS WHEN ORDERED BY FARMERS.

In the fertilizer control, the Station offers protection to farmers, in seeing that the claims of manufacturers for their goods are sustained. The manufacturers on their part pay the license tax for the privilege of selling their brands in the State. Official inspectors take samples of the brands after they are out of the control of the manufacturers. The Experiment Station analyzes these samples to see that the guarantee is maintained. So much for the official control of licensed brands.

There is nothing in the present law to prevent any person, acting for himself alone, from ordering any unlicensed brand of fertilizer *for his own use*. He does it, however, at his own risk, for the Station can offer him no protection in the way of analyzing the fertilizer. There being no restriction as to a *purchase* of this kind, either on the part of the buyer or seller, we can offer no protection to the *purchaser*.

FERTILIZERS DURING 1888.

The number of brands licensed for sale during the year 1888 is but little different from that of 1887.

In order to show the character of the trade for the year, and for comparison of several years past, the subjoined table is inserted, giving the number and description of the different brands on sale in the State. It will be noted, however, that as the licenses do not lapse with the calendar year, a single license can extend through portions of two years. The numbers, therefore, do not show the actual number of licenses issued.

	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
"Acid phosphates," or simple superphosphate.....	8	10	11	7	9	11	10	9
Superphosphates with potash ..	9	15	15	10	10	9	8	7
Ammoniated superphosphates..	40	55	61	56	63	66	58	62
Natural guanos.....	1	3	2	3	2	3	1	1
Agricultural line.....	1	1	2	1	1	1	...	...
Specialties.....	...	2	1	...	...	...	...	...
	59	86	92	80	85	90	77	79

The average composition of ammoniated superphosphates with potash show with some slight fluctuations, a marked improvement over that of former years.

AMMONIATED SUPERPHOSPHATES, WITH POTASH.

	1880.	1882.	1883.	Average in		1886.	1887.	1888.
Available phosphoric acid.....	7.40	8.91	8.59	8.15	9.13	8.69	8.54	9.11
Ammonia	2.70	2.60	2.33	2.67	2.65	2.53	2.43	2.61
Potash.....	1.30	1.82	2.18	2.13	2.34	2.30	2.08	2.33
Valuation on the 1888 basis...\$	18.28	20.61	19.48	19.92	21.25	20.33	19.62	21.19

It will be noticed that from 1880 to 1888, the increase in available phosphoric acid has been decided, amounting to 1.61 per cent., the ammonia has been remarkably close for all of the years, the potash from 1.30 in 1880 to 2.33 in 1888, or an increase of over one per cent. Using the seaboard valuation of 1888 for all the years, viz.: Available phosphoric acid, 6c. per lb.; for ammonia, 15c. per lb.; for potash, 5c. per lb.; the valuation per ton has increased from \$18.28 to \$21.19, a total increase of \$2.91 from the years 1880 to 1888.

As to the cost of these fertilizers to the farmers the change has been more decided. In 1877, when the Station was established, the average cash price of the ammoniated fertilizer was \$43.50 per ton. This same fertilizer in 1888 could be bought for \$27.50—a reduction in price of \$16.00 per ton. This means that our farmers in 1888 could buy for three million dollars what they paid over four million for in 1877. And not only this, but the average fertilizer is $\frac{1}{6}$ (one-sixth) better than it was in 1880. It is not claimed that the Station was the sole cause of this reduction, but that by a judicious control of the trade in renewing confidence between the dealers and consumers—in the prevention of fraud—in producing healthy competition, it aided largely towards this end.

In the last table the figures for 1885 and 1888 are nearly identical and express the maximum of those in the other years. It is hardly expected that these figures will be exceeded in years to come, for the simple reason that now they are as high as can be made with the composition of the ingredients now generally used for making fertilizers.

The cost of the different ingredients for 1888 is as low as will be reached, and possibly the minimum has been recorded in this year. In fact, indications now point to a marked advance in these ingredients, and there is every reason to believe that prices for 1889 will rule at least 10 to 15 per cent. higher than for the past season.

An investigation of these licensed brands as to the States in which they were manufactured, will be interesting. On this basis the following table has been compiled:

WHERE THE FERTILIZERS ARE MANUFACTURED.

	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Massachusetts.....	2	3	...	2	2	3	1	4	6
Connecticut.....	1	2	2	4	3	3	1	2	1
New York.....	3	6	5	3	2	4	3	1	1
New Jersey.....	3	3	1	1	1	2	3	2	4
Delaware.....	2	2	2	2	2	4	4	4	3
Maryland.....	21	25	45	42	30	31	35	29	25
Pennsylvania.....	...	...	1	1	...	...	1	...	1
Virginia.....	7	9	15	17	20	18	21	14	12
North Carolina.....	3	3	6	6	8	9	10	11	13
South Carolina.....	5	6	9	14	12	11	11	10	13
Totals	47	59	86	92	80	85	90	77	79

A casual glance at the above table will show how the number of fertilizers accredited to the States of Virginia, North Carolina and South Carolina, have increased, notably so in the case of North Carolina, where the increase has been over fourfold within eight years.

As illustrating this fact the following calculation is inserted which shows the per cent. of these brands which were manufactured in the three States before mentioned for the different years:

THE NUMBER OF BRANDS MANUFACTURED IN THE THREE STATES, VIRGINIA, NORTH CAROLINA AND SOUTH CAROLINA, FOR THE YEARS 1880 TO 1888,
IN PER CENTS OF THE WHOLE NUMBER.

	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888
Virginia	} 31.92	30.50	34.88	40.21	50.00	44.70	46.67	45.45	48.10
North Carolina.....									
South Carolina.. ..									

In reference to North Carolina alone, the change is more decided.

THE NUMBER OF BRANDS MANUFACTURED IN NORTH CAROLINA FOR THE YEARS 1880 TO 1888, IN PER CENTS OF THE WHOLE NUMBER.

	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
North Carolina.....	6.38	5.08	6.97	6.52	10.00	10.47	11.11	14.30	16.46

Here the increase is nearly threefold. What does this change foretell? Considering the number of brands as indicative of the amount sold, which can safely be said, since the conditions for the various years have remained unaltered, these figures prove almost conclusively that the home manufacturers are gradually driving the other more distant competitors from the field; that the distance from the source of supply of the various ingredients, and from the market where the fertilizers are sold, and the consequent high freights which these fertilizers must pay to reach a market, are proving each year to be a more effectual barrier, in a commercial point of view, to their entering the State. Taking our own State and the two adjoining, it is plainly seen that the three, while they controlled one-third of the trade eight years ago, now control one-half. North Carolina alone, eight years ago, controlled only one-sixteenth, now controls one-sixth. With this increase, and there is now no reason why it should not continue, it is not hazardous to assert that *in ten years, one-half of the commercial fertilizers sold in North Carolina will be made in North Carolina.* An additional reason for this assertion is, that the State, either alone or by calling on South Carolina, can furnish the raw ingredients sufficient to make all of the fertilizers needed here. With our comparatively inexhaustible beds of phosphates, which will be surely worked in the future much more extensively than at present, it very probably will not be necessary to procure any of the raw materials from South Carolina.

FERTILIZER ANALYSES AND VALUATION DURING 1888.

In the following pages are inserted the analyses of official samples from the inspectors, completed for the season of 1888. The samples were all taken from goods received after the beginning of the year, and at least 10 per cent. of the bags or packages were sampled in each case. The inspectors are always especially cautioned not to sample goods which have been exposed in any way, so that their quality may have been injured.

Last year was rated at the seaboard:

Available phosphoric acid,	. . .	6½ cents per pound.
Ammonia,	. . . . .	16 cents per pound.
Potash,	. . . . .	5 cents per pound.

This year, on account of the decreased cost, the ingredients are rated at the seaboard:

Available phosphoric acid,	. . .	6 cents per pound.
Ammonia,	. . . . .	15 cents per pound.
Potash,	. . . . .	5 cents per pound.

These values are chosen, not to represent the exact cost of the ingredients at the seaboard, but as an approximation of the value of these ingredients after they are mixed, bagged, and ready for sale in manipulated goods. Approximately these values then, when calculated in fertilizers, indicate the cost at which the fertilizers can be purchased at the ports in small lots, less than 5 tons, *for cash*. At interior points, freight to those points should be added. At best, however, these commercial values are approximate only. Their chief importance is to facilitate comparison between the various brands, though even here discretion must be used. A knowledge of what special ingredients, whether phosphoric acid, ammonia or potash, are needed for particular soils, should guide every one in their selections.

The standard methods of the association of official agricultural chemists are used for every determination in the analyses. The Station's Laboratory Register No. is given on the pages to the left, as well as the brand name, name of the manufacturer or general agent, and the locality where the sample was taken.

All the figures (except valuation) are given in parts per 100.

Water is the amount of moisture lost by continued heating of the fertilizers, exactly at the temperature of boiling water (212° F.) and no higher.

Insoluble phosphoric acid embraces that form of phosphoric acid which is insoluble in standard neutral solution of ammonium citrate (specific gravity 1.09) according to the methods referred to above.

Reverted phosphoric acid represents the phosphoric acid (other than the soluble in water) which will dissolve in this solution.

Soluble phosphoric acid is that form of phosphoric acid which will dissolve in pure water at ordinary temperature.

Total available phosphoric acid is the sum of the reverted and soluble phosphoric acid, since these forms are generally conceded to be readily *available* to the plants in the soil. The total available phosphoric acid must not be confounded with total phosphoric acid, which is the sum of the three forms given above—the insoluble, the reverted, and the soluble phosphoric acid. Oftentimes the phosphoric acid in either of these forms is given in the equivalent of “bone phosphate,” “phosphate of lime,” or “tricalcic phosphate”—and expresses the combination in which the acid occurs in the fertilizer. The factor for converting the phosphoric acid into the bone phosphate is 2.183.

Ammonia. The valuable element found in ammonia (NH_3), organic nitrogenous materials, and nitrates, is nitrogen (N). The quantity of this latter element is estimated, by the method used, whether occurring in either of these forms, and calculated to ammonia.

Potash is given as actual potash (K_2O) and not in any of its combinations. This potash is readily dissolved by water.

Relative commercial value per ton. These valuations are intended to show at what prices approximately the fertilizers can be purchased *at the seaboard* for cash in small lots of 5 tons and under.

The following calculation will illustrate how the relative commercial values are obtained from the analyses:

8.40 per cent. available phosphoric acid=8.40 pounds per 100, at 6 cents per pound,	\$ 0.50 40
2.35 per cent. ammonia=2.35 pounds per 100, at 15 cents per pound,	.35 25
1.87 per cent. potash=1.87 pounds per 100, at 5 cents per pound,	.09 35
Value per 100 pounds,	\$.95 00
	20
Relative commercial value per ton (2,000 pounds),	\$19.00 00

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
4639	Acid Phosphate.....	Rasin Fertilizer Co., P. O. Box 715 Baltimore, Md.....	Greenville	1
4626 } 4699 }	Acme Fertilizer.....	Acme Manufacturing Co., Wil- mington, N. C.....	Fair Bluff..... Clarkton	2
4670 } 4762 }	Ammoniated Dissolved Bone.....	John Merryman & Co., 24, 2d st., Baltimore, Md... ..	Raleigh..... Shelby.....	3
4701 } 4716 }	Ammoniated Dissolved Bone Phosphate.....	H. S. Miller & Co., Newark, N. J.,	Goldsboro	4
4623 } 4705 }	Ammoniated Soluble Na- vassa Guano.....	Navassa Guano Co., Wilmington, N. C.....	Fair Bluff..... Smithfield.....	5
4722 } 4806 }	Anchor Brand for Tobacco	Southern Fertilizing Co., 1321 Cary st., Richmond, Va.....	Warrenton..... Oxford.....	6
4632 } 4775 } 4790 }	Ashley Acid Phosphate...	Ashley Phosphate Co., Charleston, S. C.....	Wadesboro	7
4683	Ashepoo Acid Phosphate,	Ashepoo Phosphate Co., Robert- son, Taylor & Co., Agents, Charleston, S. C.....	Salisbury	8
4686	Ashepoo Fertilizer.....	Ashepoo Phosphate Co., Charles- ton, S. C.....	McFarland.....	9
4678	Atlantic Acid Phosphate..	Atlantic Phosphate Co., Charles- ton, S. C.....	McFarland.....	10
4691 } 4748 }	Baker's Standard Guano...	Chemical Co., of Canton, 32, 34 S. Charles st., Baltimore, Md.....	Cameron	11
4712	Baugh's Animal Bone and Potash Compound.....	Baugh & Sons' Co., Baltimore, Md.,	Franklinton.....	12
4659 } 4713 } 4772 }	Bono Fertilizer.....	Bono Fertilizer Co., Baltimore, Md.,	Littleton	13
4665 } 4807 }	"Bos" Ammoniated Su- perphosphate	Wm. Davison & Co., Box 227, Baltimore, Md.....	Oxford..... Oxford.....	14
4634	Bradley's Patent Super- phosphate of Lime.....	Wm. L. Bradley, 27 Kilby st., Boston, Mass.	Rocky Mount...	15
4718 } 4731 }	British Mixture.....	E. B. Whitman, 104 S. Charles st., Baltimore, Md.....	Franklinton..... Milton	16
4697	Chesapeake Guano.....	Chesapeake Guano Co., 21 P. O. Avenue, Baltimore, Md.....	Lumberton	17

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL. PHOS. ACID.		Nitrogen.	EQUIV. TO AM- MONIA.		POTASH.		Rel. com. val. per ton at the seab'd.
					F'n'd	Guar't'd		F'n'd	Guar't'd	F'n'd	Guar't'd	
1	12.71	0.84	10.16	4.61	14.77	13 to 15	0.09	0.11	0.1 to 0.3	.....	.....	\$18.05
2	14.00	0.77	7.52	1.16	8.68	8.00	2.46	2.99	3.00	2.89	2½	22.28
	13.93	0.58	7.96	0.90	8.86	8.00	2.63	3.19	3.00	2.92	2½	23.12
3	12.35	2.96	7.65	1.16	8.81	8.00	2.09	2.54	2.00	2.01	1.00	20.20
	11.59	2.02	8.11	2.10	10.21	8.00	1.97	2.39	2.00	1.80	1.00	21.22
4	13.35	0.83	10.22	0.22	10.44	8 to 10	1.90	2.31	2 to 2½	3.30	1½ to 2	22.76
	10.95	4.11	7.41	1.31	8.72	8 to 10	2.01	2.44	2 to 2½	2.83	1½ to 2	20.61
5	14.07	3.84	4.86	3.34	8.20	9.00	2.38	2.89	2.75	2.07	1.25	20.58
	13.96	4.00	4.91	3.40	8.31	9.00	2.50	3.04	2.75	1.96	1.25	21.05
6	10.21	4.98	6.12	2.05	8.17	8½ to 10	2.55	3.10	3 to 3½	1.54	1½ to 2	20.64
	13.58	3.81	6.68	1.36	8.04	8½ to 10	2.50	3.04	3 to 3½	1.90	1½ to 2	20.67
7	14.68	2.48	6.74	3.50	10.24	10	.....	.....	.....	1.43	1	13.72
	10.19	3.89	5.99	5.43	11.42	10	.....	.....	.....	0.20	...	13.92
	12.17	2.90	6.79	3.87	10.66	.....	.....	.....	.....	1.24	.....	14.03
8	14.06	1.75	9.93	1.50	11.43	10.00	.....	.....	.....	1.91	1.00	15.63
9	13.76	2.62	8.15	1.79	9.94	8.00	1.97	2.39	2.00	1.63	1.00	20.73
10	12.19	3.77	8.35	2.45	10.80	10.00	.....	.....	.....	0.42	.....	13.38
11	13.28	3.63	5.39	2.53	7.92	8 to 10	1.80	2.19	2 to 3	2.66	2 to 3	18.73
	12.43	3.10	5.25	3.07	8.32	8 to 10	1.74	2.11	2 to 3	2.19	2 to 3	18.50
12	11.52	3.90	5.36	2.33	7.69	6 to 8	1.67	2.03	2 to 2½	3.58	2 to 3	18.90
13	11.37	2.80	5.82	3.14	8.96	9 to 11¼	1.83	2.22	.....	2.60	1¼ to 1¾	20.01
	10.77	3.24	6.23	2.52	8.75	9 to 11¼	1.93	2.34	2½ to 3	2.74	1½ to 1¾	20.26
	12.43	1.24	7.41	2.22	9.63	9 to 11¼	2.04	2.48	2½ to 3	1.94	1½ to 1¾	20.94
14	13.20	1.71	8.11	2.38	10.49	8 to 10	2.23	2.71	2½ to 3	2.36	2½ to 3	23.08
	12.83	2.15	7.37	2.04	9.41	8 to 10	2.10	2.55	2½ to 3	3.39	2½ to 3	22.33
15	13.51	2.74	7.75	1.50	9.25	9.45	2.03	2.46	2.40	1.42	1.00	19.90
16	10.95	1.96	7.66	1.19	8.85	8 to 10	2.13	2.59	2 to 3	1.74	2 to 3	20.13
	12.06	1.29	8.29	1.14	9.43	8 to 10	2.33	2.83	2 to 3	1.81	2 to 3	21.62
17	13.41	3.11	5.37	4.25	9.62	8 to 10	1.81	2.20	2 to 2½	1.49	1.5 to 2	19.63

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
4648 } 4735 } 4776 }	Diamond Soluble Bone....	Walton, Whann & Co., Wilming- ton, Del... ..	Washington Greensboro..... Salisbury	18
	Diamond State Super- phosphate	Lord & Polk, Odessa, Delaware....	.....	19
4702	Dissolved Bone Phosphate of Lime, Pacific.....	Pacific Guano Co., Woods Holl, Mass, Glidden & Curtis, Gen. Agents, Boston, Mass.....	Lumberton	20
4679 } 4809 } 4810 }	Durham Ammoniat'd Fer- tilizer	Durham Fertilizer Co., Durham, N. C.....	Charlotte Greensboro..... Greensboro.....	21
4719	Durham Ammoniat'd Fer- tilizer with Peruvian Guano.....	Durham Fertilizer Co., Durham, N. C.....	Franklinton	22
4680	Edisto Dissolved Bone....	Edisto Phosphate Co., Charleston, S. C.....	Concord.....	23
	Eddystone Soluble Guano,	Clark's Cove Guano Co., New Bed- ford, Mass., John M. Green, Man- ager, Atlanta, Ga.....	.....	24
4663	Empire Guano	Rasin Fertilizer Co., P. O. Box 715 Baltimore, Md	Franklinton	25
	Etiwan Ammoniated Su- perphosphate	Etiwan Phosphate Co., Charleston, S. C.....	.....	26
4641 } 4669 }	Etiwan Dissolved Bone...	Etiwan Phosphate Co., Charleston, S. C.....	Wilson..... Raleigh.....	27
4646	Excellent Georgia Stand- ard	Wilcox & Gibbs Guano Company, Charleston, S. C.....	Washington	28
4635 } 4664 }	Farmers' Bone Fertilizer,	Tarboro Oil Mills, Tarboro, N. C.,	Tarboro Franklinton....	29
4636 } 4685 } 4812 }	Farmers' Friend Fertil- zer	Read & Co., 88 Wall street, New York	Greenville..... Charlotte..... Salisbury	30
4761 } 4808 }	Game Guano.....	Baltimore Guano Co., 32 S. Charles st., Baltimore, Md.	Concord Concord.....	31
3698 } 4714 }	Gem Fertilizer	Acme Manufacturing Co., Wilming- ton, N. C.....	Lumberton Littleton	32
4621	Gibbs & Co.'s High Grade Ammoniated Phosphate,	E. J. Powers, Wilmington, N. C...	Laurinburg ...	33

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL. PHOS. ACID.		Nitrogen.	EQUIV. TO AM- MONIA.		POTASH.		Rel. com. val. per ton at the seab'd.
					F'n'd	Guar't'd		F'n'd	Guar't'd	F'n'd	Guar't'd	
18	11.50	2.58	9.35	4.02	13.37	12 to 15	.....	.....	.....	.....	.....	\$ 16.04
	11.52	4.34	10.18	2.47	12.65	12 to 15	.....	.....	.....	.....	.....	15.18
	15.74	1.85	10.41	3.03	13.44	12 to 15	.....	.....	.....	.....	.....	16.13
19	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	15.48	4.84	9.84	1.63	11.47	10 to 12	.....	.....	.....	.....	.....	13.76
21	12.76	1.74	6.33	1.46	7.79	8 to 10	2.08	2.53	2 to 3	2.42	1 $\frac{3}{4}$ to 2 $\frac{1}{4}$	19.36
	8.62	3.62	3.70	6.66	10.36	8 to 10	2.14	2.60	2 $\frac{1}{2}$ to 3	2.05	1 $\frac{3}{4}$ to 2 $\frac{1}{4}$	22.28
	9.42	2.99	6.01	3.62	9.63	8 to 10	1.83	2.22	2 $\frac{1}{2}$ to 3	1.67	1 $\frac{3}{4}$ to 2 $\frac{1}{4}$	19.89
22	9.63	1.94	6.50	4.16	10.66	8 to 10	1.93	2.34	2 $\frac{1}{2}$ to 3	2.04	1 $\frac{3}{4}$ to 2 $\frac{1}{4}$	21.85
23	15.27	1.29	12.10	2.00	14.10	12 to 14	.....	.....	.....	.....	.....	16.92
24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
25	14.73	1.80	5.27	3.00	8.27	8 to 10	2.02	2.45	2 to 3	2.23	1 $\frac{1}{2}$ to 1 $\frac{8}{10}$	19.50
26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
27	16.14	1.93	10.72	2.01	12.73	13 to 15	.....	.....	.....	.....	.....	15.28
	16.85	2.72	10.63	1.64	12.27	.....	.....	.....	.....	.....	.....	14.72
28	13.29	2.17	5.44	2.00	7.44	8.00	2.03	2.46	2.00	2.04	1.00	18.35
29	12.00	0.58	5.07	2.04	7.11	8 to 9	2.40	2.91	2 to 3	2.81	1.5 to 2.5	20.07
	15.20	0.59	5.37	2.05	7.42	8 to 9	2.19	2.66	2 to 3	3.76	1 $\frac{1}{2}$ to 2 $\frac{1}{2}$	20.64
30	11.65	2.32	6.08	2.85	8.93	9 to 11	1.93	2.34	2 $\frac{1}{4}$ to 3 $\frac{1}{4}$	1.21	1 to 2	18.95
	13.85	2.16	7.61	1.95	9.56	9 to 11	1.98	2.40	2 $\frac{1}{4}$ to 3 $\frac{1}{4}$	1.38	1 to 2	20.05
	15.90	1.09	7.07	2.14	9.21	9 to 11	2.00	2.43	2 $\frac{1}{4}$ to 3 $\frac{1}{4}$	1.71	1 to 2	20.05
31	15.14	3.40	5.32	2.88	8.20	8 to 10	2.19	2.66	2 to 3	2.95	2 to 3	20.77
	14.53	2.26	6.26	2.20	8.46	8 to 10	1.65	2.00	2 so 3	2.37	2 to 3	18.52
32	12.11	0.61	7.62	1.45	9.07	8.00	1.80	2.19	2.00	2.89	2.00	20.34
	12.64	0.61	7.29	1.30	8.59	8.00	1.65	2.00	2.00	2.90	2.00	19.21
33	15.82	1.06	7.45	2.33	9.78	8 to 10	2.09	2.54	2 to 3	1.69	1 to 2	21.05

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
4764	H. S. Miller & Co.'s Har- vest Queen.....	H. S. Miller & Co., Newark, N. J.,	Concord	34
4657	Harvest Queen Phosphate,	Lister's Agricultural Chem. Works, Newark, N. J.....	Littleton	35
4645 } 4696 }	High Grade Premium Guano	George L. Arps, Norfolk, Va.....	Washington Goldsboro.....	36
4668	L. & R. Acid Phosphate...	Lorentz & Rittler, 70 South st., Baltimore, Md.....	Raleigh..	37
4704 } 4759 } 4815 }	L. & R. Ammoniated Guano.....	Lorentz & Rittler, 70 South st., Baltimore, Md... ..	Selma..... Shelby..... Oxford.. ..	38
4642 } 4724 }	Lazaretto Acid Phosphate,	Lazaretto Chem. and Fert. Works, G. W. Grafflin, Prop'r, 14 S. Hol- liday st., Baltimore, Md.....	Fremont	39
4654	Lister's Ammoniated Dis- solved Bone Phosphate,	Lister's Agricultural Chemical Works, Newark, N. J.....	Littleton	40
4666	Long's Prepared Chemi- cals	John R. Long & Co., Baltimore, Md.....	Franklinton	41
4620	Meadows' Special Guano for all crops.....	E. H. & J. A. Meadows, New- bern, N. C... ..	Newbern	42
4628 } 4720 } 4804 }	National Fertilizer	S. W. Travers & Co., Richmond, Va.....	Wadesboro	43
4640	Navassa Acid Phosphate,	Navassa Guano Co., Wilmington, N. C.....	Wilson	44
4725 } 4843 }	No. 1 Peruvian Guano, Imported	Smith & Gilchrist, Wilmington, N. C.....	Oxford Henderson	45
4637	Owl Brand Guano.....	Davie & Whittle, Petersburg, Va...	Rocky Mount...	46
4758 } 4811 }	Owl Brand Tobacco Guano	Davie & Whittle, Petersburg, Va...	Asheville..... Greensboro.....	47
4671 } 4700 } 4805 }	Patapsco Guano.....	Patapsco Guano Co., 14 S. Holli- day st., Baltimore, Md.....	Raleigh..... Maxton Oxford	48
	Peruvian Mixture.....	American Fertilizing Co., Nor- folk, Va... ..	.....	49
4703	Piedmont Special Fertil- izer	Piedmont Guano Manufacturing Co., 49 South st., Baltimore, Md.,	Smithfield	50

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL. PHOS. ACID.		Nitrogen.	EQUIV. TO AM- MONTA.		POTASH.		Rel. com. val. per ton at the seab'd.
					F'n'd	Guar't'd		F'n'd	Guar't'd	F'n'd	Guar't'd	
34	9.68	1.36	10.90	1.29	12.19	10 to 12	1.23	1.49	1 to 2	2.14	1½ to 2	\$ 21.24
35	13.07	1.96	9.02	1.90	10.92	10 to 12	1.29	1.57	1 to 2	1.70	1.5 to 2	19.51
36	9.58	1.83	7.54	1.32	8.86	8.00	1.90	2.31	2.00	2.29	1.00	19.85
	14.31	1.88	7.73	1.21	8.94	8.00	2.12	2.57	2.00	2.13	1.00	20.57
37	14.00	3.11	10.12	1.62	11.74	12 to 15	.....	.....	.....	.....	.....	14.09
38	14.05	3.62	7.20	0.85	8.05	8 to 10	1.56	1.89	2 to 2½	3.10	1½ to 2	18.43
	13.40	5.16	6.32	1.25	7.57	8 to 10	1.90	2.31	2 to 2½	1.89	1½ to 2	17.90
	12.50	4.21	6.27	1.95	8.22	8 to 10	1.69	2.05	2 to 2½	1.96	1½ to 2	17.97
39	17.70	0.93	9.36	3.36	12.72	14.13	.....	.....	.....	.....	.....	15.26
	17.77	0.75	9.98	3.28	13.26	13 to 18	.....	.....	.....	.....	.....	15.91
40	14.99	1.28	9.24	1.36	10.60	8.00	2.00	2.43	2.00	1.85	1.00	21.86
41	13.17	2.30	11.16	1.70	12.86	12.00	.....	.....	.....	2.57	1.80	18.00
42	13.36	1.25	7.52	1.61	9.13	9 to 11	1.88	2.28	2½ to 3	2.91	2½ to 3	20.71
43	13.88	2.20	7.14	1.56	8.70	8 to 10	1.66	2.02	2 to 3	2.02	2 to 3	18.52
	10.36	3.48	6.01	2.20	8.21	8 to 10	1.83	2.22	2 to 3	1.55	2 to 3	18.06
	11.63	.99	7.85	1.37	9.22	8 to 10	2.15	2.61	2 to 3	2.90	2 to 3	21.79
44	17.72	0.86	10.26	1.98	12.24	10.50	.....	.....	.....	1.63	1.25	16.32
45	16.14	4.44	6.27	5.47	11.74	13	6.86	8.33	9.50	3.25	2	42.33
	16.79	4.38	7.83	2.89	10.72	13	7.78	9.44	9.50	3.04	2	44.32
46	16.97	1.62	7.24	1.83	9.07	8.00	1.69	2.05	2.00	1.72	1.00	18.75
47	15.95	2.00	8.19	1.07	9.26	9 to 11	2.55	3.10	2½ to 3½	1.99	1¾ to 2½	22.40
	14.20	2.28	7.98	1.30	9.28	9¼	2.44	2.96	2¾	1.98	1¾	22.00
48	13.80	1.61	8.32	0.98	9.30	8 to 10	2.04	2.48	2½ to 3	1.22	1½ to 2	19.82
	14.26	1.60	8.39	1.40	9.79	8 to 10	2.12	2.57	2½ to 3	1.46	1½ to 2	20.92
	13.68	2.49	7.14	2.66	9.80	8 to 10	2.28	2.77	2¼ to 3	1.83	1½ to 2	21.90
49	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
50	14.85	1.62	7.18	2.50	9.68	8 to 10	1.85	2.25	2 to 2½	1.73	1 to 1½	20.10

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
4733 } 4771 }	Piedmont Guano for Tobacco	Piedmont Guano Manufacturing Co., 49 South st., Baltimore, Md.,	Reidsville..... Durham.....	51
4622 } 4695 }	Pine Island Ammoniated Phosphate.....	Quinnipiac Fertilizer, New London, Conn.....	Wilmington.... Goldsboro.....	52
4644	Pocomoke Superphosphate	E. B. Freeman, Norfolk, Va.....	Washington	53
4627 } 4707 }	Prolific Cotton Grower....	Goldsboro Oil Company, Goldsboro, N. C.....	Smithfield Kinston	54
4726 } 4774 }	Raleigh Standard Guano,	Raleigh Oil Mills and Fertilizing Co., Raleigh, N. C.....	Wake Forest.... Chapel Hill....	55
4638 } 4717 }	Raw Bone Superphosphate, Plow Brand.....	Walton, Whann & Co., Wilmington, Del.....	Wilson..... Louisburg.....	56
4688	Red Navassa Guano, Ammoniated.....	Navassa Guano Co., Wilmington, N. C.....	McFarland	57
4631	Royster's High Grade Acid Phosphate.. ...	Royster & Strudwick, Norfolk, Va.,	Maxton.....	58
4658 } 4684 }	Sea Fowl Guano.....	Wm. L. Bradley, Boston, Mass....	Edenton. Charlotte... ..	59
4653 } 4692 } 4814 }	Soluble Pacific Guano.....	Pacific Guano Co., Woods Holl, Mass., Glidden & Curtis, Gen. Agents, Boston, Mass.....	Henderson Cameron Oxford	60
	Soluble Pacific Guano for Tobacco	Pacific Guano Co., Woods Holl, Mass., Glidden & Curtis, Gen. Agents, Boston, Mass.....	.....	61
4630	Special Cotton Compound,	G. Ober & Sons' Co., 85 Exchange Place, Baltimore, Md.....	Laurinburg	62
4662 } 4803 }	Special Com. for Tobacco, Phosphate and Alkalies,	G. Ober & Sons' Co., 85 Exchange Place, Baltimore, Md.....	Oxford Oxford	63
4655 } 4723 }	Star Brand Guano.....	Allison & Addison, 1322 Cary st., Richmond, Va	Warrenton Warrenton	64
4746	Star Brand Special Tobacco Manure.....	Allison & Addison, 1322 Cary st., Richmond, Va.....	Germantown....	65
4661 } 4687 }	Stonewall Brand Fertilizer	Jas. G. Tinsley & Co., Richmond, Va.....	Oxford Salisbury	66
4682	Stono Acid Phosphate....	Stono Phosphate Co., Charleston, S. C.....	Salisbury	67

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL. PHOS. ACID.		Nitrogen.	EQUIV. TO AM MONIA.		POTASH.		Rel. com. val. per ton at the seab'd.
					F'n'd	Guar't'd		F'n'd	Guar't'd	F'n'd	Guar't'd	
51	13.49 14.71	2.83 2.37	5.59 5.63	2.15 2.95	7.74 8.58	8 to 10 8 to 10	2.41 2.30	2.93 2.79	2½ to 3 2½ to 3	3.64 3.87	2½ to 3 2½ to 3	\$ 21.72 22.54
52	16.41 15.02	2.15 2.28	8.42 8.24	2.01 1.67	10.43 9.91	8.00 8.00	2.20 2.35	2.67 2.85	2.00 2.00	1.43 1.54	1.00 1.00	21.96 21.98
53	11.75	2.46	6.68	2.21	8.89	8½	2.24	2.72	2.00	2.14	1.50	20.97
54	10.50 9.23	1.68 1.22	6.61 5.97	1.61 2.57	8.22 8.54	8½ to 10½ 9 to 10½	1.72 2.15	2.09 2.61	2½ to 3 2½ to 3	3.85 3.87	2 to 2½ 2 to 2½	19.98 21.95
55	9.98 10.73	1.38 1.60	6.84 6.41	2.00 2.28	8.84 8.69	9 to 11 8 to 10	2.21 2.18	2.68 2.65	3 to 3½ 2¾ to 3¼	2.21 2.04	2 to 2½ 1½ to 2	20.86 20.42
56	11.72 10.97	4.11 4.43	6.05 6.97	3.08 2.39	9.13 9.36	9 to 11 9 to 11	2.19 2.06	2.66 2.50	2½ to 3½ 2½ to 3¼	2.32 2.51	2¼ to 2¾ 2¼ to 2¾	21.26 21.24
57	14.58	1.54	8.48	1.81	10.29	9 to 11	1.58	1.92	1½ to 2½	2.13	1.25 to 2	20.24
58	16.85	1.83	11.27	2.07	13.34	11 to 13	.....	.....	.....	.....	.....	16.01
59	13.90 14.86	2.19 2.79	8.37 8.47	1.61 1.44	9.98 9.91	9.45 9.45	2.06 2.02	2.50 2.45	2.40 2.40	1.13 1.74	1.00 1.00	20.61 20.98
60	13.93 13.86 13.12	2.81 2.32 1.77	6.52 7.27 6.49	2.39 2.69 2.61	8.91 9.96 9.10	8 to 10 8 to 10 8 to 10	2.04 2.10 2.46	2.48 2.55 2.99	2 to 2½ 2 to 2½ 3 to 3.75	1.81 1.68 3.86	1 to 1¼ 1 to 1¼ 3.50 to 4.37	19.94 21.28 23.75
61	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
62	15.09	1.41	8.17	0.96	9.13	8 to 10	1.94	2.36	2 to 3	2.25	1.40 to 2	20.28
63	14.50 13.38	2.21 3.47	7.97 7.81	0.44 1.33	8.41 9.04	8 to 10 8 to 10	2.20 2.18	2.67 2.65	2.5 to 3.5 2.5 to 3.5	3.10 3.61	1.5 to 2.5 1.5 to 2.5	21.20 22.41
64	14.28 13.92	1.74 1.61	6.60 6.93	1.84 1.58	8.44 8.51	7 to 8 7 to 8	1.62 1.64	1.97 1.99	1¾ to 2 1¾ to 2	1.53 1.44	1¼ to 1½ 1¼ to 1½	17.57 17.62
65	12.81	2.11	8.26	2.64	10.90	8 to 10	2.50	3.04	2½ to 3	1.95	1¼ to 1½	24.15
66	13.69 13.01	2.26 2.12	6.98 7.46	1.76 1.79	8.74 9.25	8 to 10 8 to 10	1.44 1.73	1.75 2.10	2 to 2.5 2 to 2.5	2.77 2.94	2 to 2½ 2 to 2½	18.51 20.34
67	12.79	2.83	9.59	2.66	12.25	10.00	.....	.....	.....	1.33	1.00	16.03

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
4681	Stone Soluble Guano.....	Stono Phosphate Co., Charleston, S. C.....	Concord.	68
4660 } 4747 }	Tinsley's Tobacco Guano,	Jas. G. Tinsley & Co., 1326 Cary st., Richmond, Va.....	Oxford Walnut Cove...	69
4689	Walker's Ammo't'd Phos- phate	Joshua Walker, 13 German st., Baltimore, Md.....	Jonesboro.....	70
4625	Wando Acid Phosphate...	Wando Phosphate Co., Charles- ton, S. C.....	Fair Bluff.....	71
4624 } 4763 }	Wando Soluble Guano.....	Wando Phosphate Co., Charles- ton, S. C.....	Fair Bluff..... Shelby.....	72
4629	Wilcox, Gibbs & Co.'s Manipulated Guano....	Wilcox & Gibbs Guano Co., 78 E. Bay st., Charleston, S. C.	Fayetteville	73
4647	Wilcox, Gibbs & Co.'s Superphosphate	Wilcox & Gibbs Guano Co., 78 E. Bay st., Charleston, S. C.....	Washington	74
	Zell's Ammoniated Super- phosphate	Zell Guano Co., 30 South street, Baltimore, Md.....	.....	75
	Zell's Tobacco Fertilizer...	Zell Guano Co., 30 South street, Baltimore, Md.....	.....	76

III. CHEMICAL WORK.—Continued.

In addition to the operations of the fertilizer control embraced under (a) of the Chemical Work of the Station, which has already been set forth in detail, the chemical work also embraces:

b. Experimental Chemical Work.—The main feature of this work for 1888 has been the investigations on the "Chemical History of the Cotton Plant from Seed to Maturity." These investigations, which were commenced in 1887 by the former Director, have been greatly and very materially enlarged, so that now they include much beyond the original scope. This work has been extended to embrace a chemical analysis of each part of the cotton plant—roots, stalks, branches, leaves—at the different stages of growth. After the squares and bolls have commenced to form, these will be included, and so on, till the parts will include, in addition to those mentioned, the burrs, lint, seed hulls and seed kernels. The magnitude of this work cannot properly be appreciated till the results are printed. There are forty-four ash analyses of the various parts, each analysis embracing fourteen different determinations. In addition to the ash analyses, there will be determinations of moisture, nitrogen, and organic matter. The weighings alone will number over two thousand.

It is to be regretted that the work is not ready for publication in this report, yet to such an extent has the work grown since its commencement, that it has required a much longer time to complete it than was originally thought. Though all the chemical work has been completed, and most of the numerous calculations made, it still is in a condition only partially finished; and on this account it is thought advisable to delay publication until the whole is ready.

There also has been analyzed as well, numerous samples of forage plants and grasses, to ascertain their mineral constituents. For this climate these plants have never been examined. It may be that their quality here is essentially different from those grown elsewhere. Facilities are also being prepared to analyze with thoroughness whatever products are required by the experimental work in the field, barn or dairy.

c. Miscellaneous Chemical Work.—Under this head is included the analyses of samples sent to the Station by citizens of the State. This work the Station does without charge, provided the samples are of sufficient public importance to demand it, and is not inconsistent with the other experimental work. The Station will make the results public in whatever way it is thought best.

The following is a record of the chemical work done in 1888, including the fertilizer control, the experimental and miscellaneous chemical work:

Commercial fertilizers for the Fertilizer Control,	158
Fertilizers (for farmers),	32
Cotton plant experiments,	117
Mineral waters,	69
Drinking waters,	23
Grasses and seeds identified,	78
Ores,	78
Marls,	24
Phosphates,	17
Soils,	19
Potash salts,	11
Composts,	18
Cotton seed products,	7
Manures,	2
Tobacco stems,	3
Peat,	2
Water for boiler,	2
Wine and beer,	2
Miscellaneous,	12
	<hr/> 637

The large increase of experimental chemical work in 1888 over former years is due to the increased facilities for work and better equipment.

MARLS, LIMESTONES AND PHOSPHATES.

The following samples of marls, limestones and phosphates have been analyzed during the year. Representing as they do beds in various localities, they illustrate the inexhaustible resources of the State in ingredients suitable as permanent improvers of the soil. These beds, taken in connection with those already described in each of the former Annual Reports of the Station, will show over what extended areas these materials are found.

4618. W. M. Jones, Cary, N. C. Marl. From Mr. L. J. Haughton's farm in Jones county.

4649. J. E. Person, Fremont, N. C. Supposed marl.

4652. Gardner & Chapman, Maple Cypress, N. C. Marl.

4675. Jno. O. Bryan, Kenansville, N. C. Marl. "I have a large deposit of it."

4741. A. B. Nobles, Kinston, N. C. Marl.

4787. Dr. A. G. Brooks, Black Creek, N. C. Marl.

4821. Col. R. B. Creecy, Elizabeth City, N. C. Marl. "From a section of Pasquotank county, known as Tadmon, the most fertile part of our county, where reside the best farmers. The bed is inexhaustible, lying about five feet below the surface, and is ten miles square."

4837. A. J. Kilpatrick, Kinston, N. C. Marl. "No. 1, of marl bed, red clay."

4838. A. J. Kilpatrick, Kinston, N. C. Marl. "No. 2, top of the marl gray."

4839. A. J. Kilpatrick, Kinston, N. C. Marl. "No. 3, bottom of the marl shell and sand."

4840. A. J. Kilpatrick, Kinston, N. C. Marl. "No. 4, bottom of marl bed green sand."

4903. Hon. Francis D. Winston, Windsor, N. C. Marl.

4908. Rev. C. O. Durant, Youngsville, N. C. Marl.

4914. A. C. Oliver, Fair Bluff, N. C. Marl. "From the farm of A. C. Oliver, Jr., on Ashpole swamp, 18 miles south of Lumberton, in Robeson county."

4938. Jno. P. Gray, Snow Hill, N. C. Marl. "Plowed up in the vicinity of a hole that had been dug."

4943. Allen Warren, Greenville, N. C. Marl.

4960. T. B. Parker, Goldsboro, N. C. Marl No. 1.

4961. T. B. Parker, Goldsboro, N. C. Marl No. 2.

4966. G. A. Stancill, Tarboro, N. C. Marl No. 1. "Is gotten about 8 feet under surface."

4967. G. A. Stancill, Tarboro, N. C. Marl No. 2. "Found in same bed and just below 4966."

4968. Francis D. Winston, Windsor, N. C. Marl.

4975. R. E. Heide, Wilmington, N. C. Marl. "I have found at several places on my farm, 'Appleton,' five miles near this place; suppose the whole farm underlaid with a kind of clay or marl."

5246. A. W. Maxwell, Resaca, N. C. Marl.

4909. Rev. O. C. Durant, Youngsville, N. C. Limestone.

4604. P. M. Wilson, Raleigh, N. C. Ground Phosphate.

4605. P. M. Wilson, Raleigh, N. C. Ground Phosphate.

4606. P. M. Wilson, Raleigh, N. C. Ground Phosphate.

4607. L. J. Hall, Elizabethtown, N. C. Lime Rock. "Taken from my farm ten miles below this place on the Cape Fear river. Don't think it a fair sample, as it was taken from the edge of the rock."

4884. P. M. Wilson, Raleigh, N. C. Phosphatic Nodules. From Castle Haynes, N. C. "No. 1, finest."

4845. P. M. Wilson, Raleigh, N. C. Phosphatic Nodules. "No. 2, medium."

4886. P. M. Wilson, Raleigh, N. C. Phosphatic Nodules. "No. 3, coarser."

4933. P. M. Wilson, Raleigh, N. C. Ground Phosphate. "No. 1, fine."

4934. P. M. Wilson, Raleigh, N. C. Ground Phosphate. "No. 2, coarse."

4965. Mrs. Ellen P. Guion, Lyon's Landing, N. C. Phosphate.

Station No.	KIND.	SENDER AND ADDRESS.	Sand and In-soluble matter.	Carbonate of Lime.	Phosphate of Lime.
4618	Marl.	W. M. Jones, Cary, N. C.	63.76	32.21	2.18
4649	Blue Marl.	J. E. Person, Fremont, N. C. ....	.....	Sm. Amt	Trace.
4652	Marl.	Gardner & Chapman, Maple Cypress, N. C..	29.95	50.13	"
4675	"	Jno. O. Bryan, Kenansville, N. C.	70.69	70.60	"
4771	"	A. B. Nobles, Kinston, N. C. ....	.....	48.58	1.48
4787	"	A. G. Brooks, Black Creek, N. C.	89.30	4.23	1.96
4821	"	Col. R. B. Creecy, Elizabeth City, N. C.	62.27	26.89	1.00
4837	"	A. J. Kilpatrick, Kinston, N. C.	87.57	.18	2.99
4838	"	" " " "	45.84	33.00	2.79
4839	"	" " " "	51.69	27.06	5.25
4840	"	" " " "	76.36	1.48	5.87
4903	"	Francis D. Winston, Windsor, N. C.	68.15	19.21	0.20
4908	"	Rev. C. O. Durant, Youngsville, N. C.	57.52	33.21	.53
4914	"	A. C. Oliver, Fair Bluff, N. C.	34.42	60.14	2.93
4938	"	Jno. P. Gray, Snow Hill, N. C.	32.78	7.75	Trace.
4943	"	Allen Warren, Greenville, N. C.	47.41	37.29	"
4960	"	T. B. Parker, Goldsboro, N. C.	57.19	40.94	"
4961	"	" " " "	51.22	41.48	"
4966	"	G. A. Stancill, Tarboro, N. C.	54.94	38.05	.....
4967	"	" " " "	.80	22.04	19.11
4968	"	Francis D. Winston, Windsor, N. C.	35.79	63.39	Trace.
4975	"	R. E. Heide, Wilmington, N. C.	90.41	5.00	"
5246	"	A. W. Maxwell, Resaca, N. C.	10.21	83.38	"
4909	Limestone.	Rev. C. O. Durant, Youngsville, N. C.	12.98	84.16	.....
4607	Lime Rock.	L. G. Hall, Elizabethtown, N. C.	53.12	45.76	.....
4604	Gr'nd Phosphate	P. M. Wilson, Raleigh, N. C. ....	.....	61.03	9.42
4605	"	" " " "	.....	76.74	6.71
4606	"	" " " "	.....	78.15	6.31
4884	Phos. Nodules.	" " " "	.....	13.01	10.25
4885	"	" " " "	.....	8.44	43.17
4886	"	" " " "	.....	8.76	37.19
4933	Gr'nd Phosphate	" " " "	.....	.....	37.83
4934	"	" " " "	.....	.....	33.81
4965	Phosphate.	Mrs. Ellen P. Guion, Lyon's Landing, N. C.	.....	.....	Trace.

NORTH CAROLINA PHOSPHATES.

The Experiment Station, as one portion of its chemical work, desires to investigate the natural fertilizers of the State. With this end in view the following partial examination of the natural phosphates is appended. It may be possible in this way to benefit materially the agriculture of the State, as the mining of the green sand marl of New Jersey has undoubtedly benefited that State.*

PRELIMINARY REPORT ON THE PHOSPHATIC DEPOSITS OF PENDER AND NEW HANOVER COUNTIES, N. C.

The phosphatic deposits of Eastern North Carolina in the counties of Pender and New Hanover have been worked continuously during 1888 and '89, up to the period at which this report is printed, and the products have been extensively shipped and used throughout the State.

The examination of the present status of the beds is now going on. This preliminary report will, however, only treat of the beds mined on the Castle Haynes property in New Hanover county, owned by the N. C. Phosphate Company, C. M. Hawkins, President. These beds are located nine miles north of Wilmington, N. C., on the north side of Prince George's creek, following this creek westwardly to its junction with the North East river.

Bed A. The locality of that portion of the deposit now most extensively mined is in extent, so far as known at present, about 40 acres, and lies at the eastern limit of the Castle Haynes deposit. This mine has been worked in extent averaging 350 feet by 150 feet, and 15 feet deep, though a depth of 20 feet has been reached at some points.

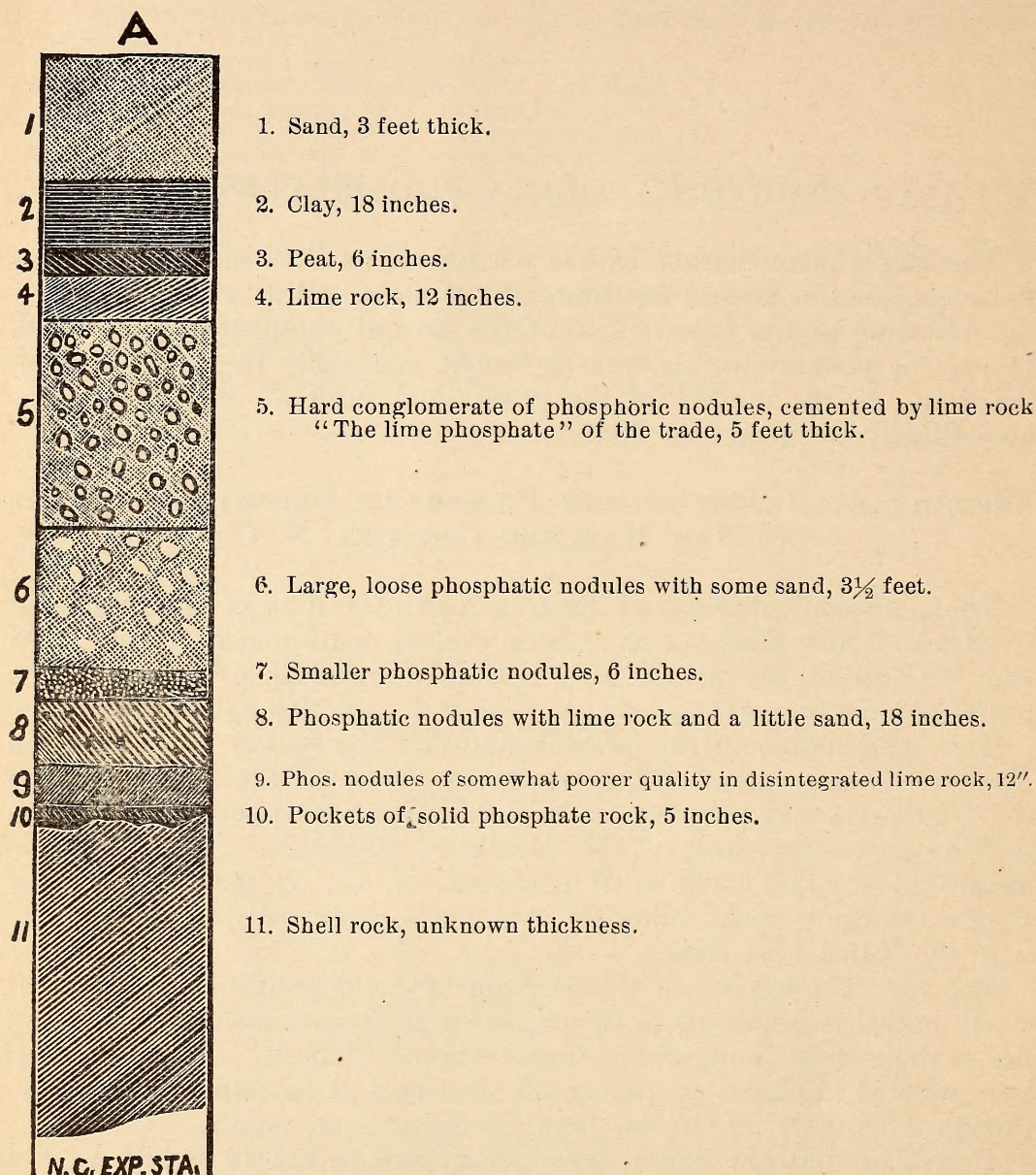
In this preliminary report, this locality will be known as bed A., and the accompanying cut (A.) will illustrate an ideal section drawn to scale and giving the averaging thickness of each stratum.

From bed A. has all the merchantable phosphatic conglomerate (when ground, known as "lime phosphate") been taken, as well as the more rich phosphatic nodules at a lower depth of a later discovery.

The merchantable phosphatic materials including the "lime phosphate" and the various nodules of different grades, rich in phosphoric acid, mined for the year ending May 1st, 1889, amounted to 2,000 tons.

*There were mined in New Jersey in 1887, 600,000 short tons, valued at \$300,000.00. The largest portion of this was used on the lands of New Jersey with great profit.

IDEAL SECTION OF CASTLE HAYNES DEPOSIT—BED A.



An ideal section (see A.) of this mine gives the relative proportion and quality of each stratum. These strata are for the most part horizontal, showing deposition. No. 1, which represents the top stratum, is sand averaging 3 feet in thickness. Next follows 18 inches of clay (No. 2), underlaid by 6 inches of peat (3). No 4 is a limestone rock from 8 to 16 inches thick, running 95 per cent. carbonate of lime. Next (5) is the conglomerate furnishing the merchantable "lime phosphate," composed of phosphatic nodules cemented solidly by nearly pure carbonate of lime. This stratum is from four to six feet thick, averaging 5 feet. Under this phosphatic conglomerate is a layer (6) of loose nodules, running from 2½ to 4 feet thick, with an average thickness of 3½ feet. This

layer contains a small amount of loose sand. The layer (7) immediately underneath averages only 4 inches in thickness, ranging from 3 to 5 inches. This bed is composed of smaller phosphatic nodules than is found in No. 6. Next is (No. 8) a bed of loose nodules and lime, containing very little sand, and is 18 inches thick. In practice it is found convenient to raise these strata together, and consequently after mining they are more or less mixed. No. 9 averages 12 inches thick, and contains nodules of somewhat poorer quality mixed with disintegrated lime rock and a small quantity of sand. Beneath this stratum are found pockets of solid phosphate rock, resembling very closely the phosphate rocks of Duplin county, N. C. Analysis shows this rock to contain a large percentage of sand. These pockets vary from 3 to 6 inches in thickness. Lastly, below 10, is found a solid shell rock (11) containing 95 per cent. of carbonate of lime and of unknown thickness. This stratum is extremely hard and only a depth of 18 inches has been reached. Owing to its toughness a dynamite cartridge exploded in it can only fracture a short distance from the drill hole. At a depth of 18 inches there appears to be no indication of any different substratum.

Portions of the various strata have been analyzed at the Station with the following results:

ANALYSIS OF STRATA IN SECTION A.

STRATA.		Moisture.	Sand.	Potash.	Carb. Lime.	Phos. Acid.	Equiv. to Phos. Lime.
No. 4.	Lime Rock.....				95.00		
" 5.	Hard conglomerate.....			.40	64.26	5.10	11.16
" 6.	a. Sand and fine phosphatic nodules.....			.15	13.01	4.70	10.25
	b. Phosphatic nodules, medium size.....				8.44	19.77	43.17
	c. Phosphatic nodules, larger size.....				8.76	17.03	37.19
" 9.	Phosphatic nodules excluding lime rock.....	1.30	29.00		7.98	20.35	44.45
" 10.	Solid phosphate in pockets....	.45	46.25		35.60	5.73	12.52
" 11.	Shell rock.....				95.00		

Through the courtesy of C. M. Hawkins, President of the company, below is given a complete analysis of the stratum No. 6, made by W. P. Frost, of Charleston, S. C.:

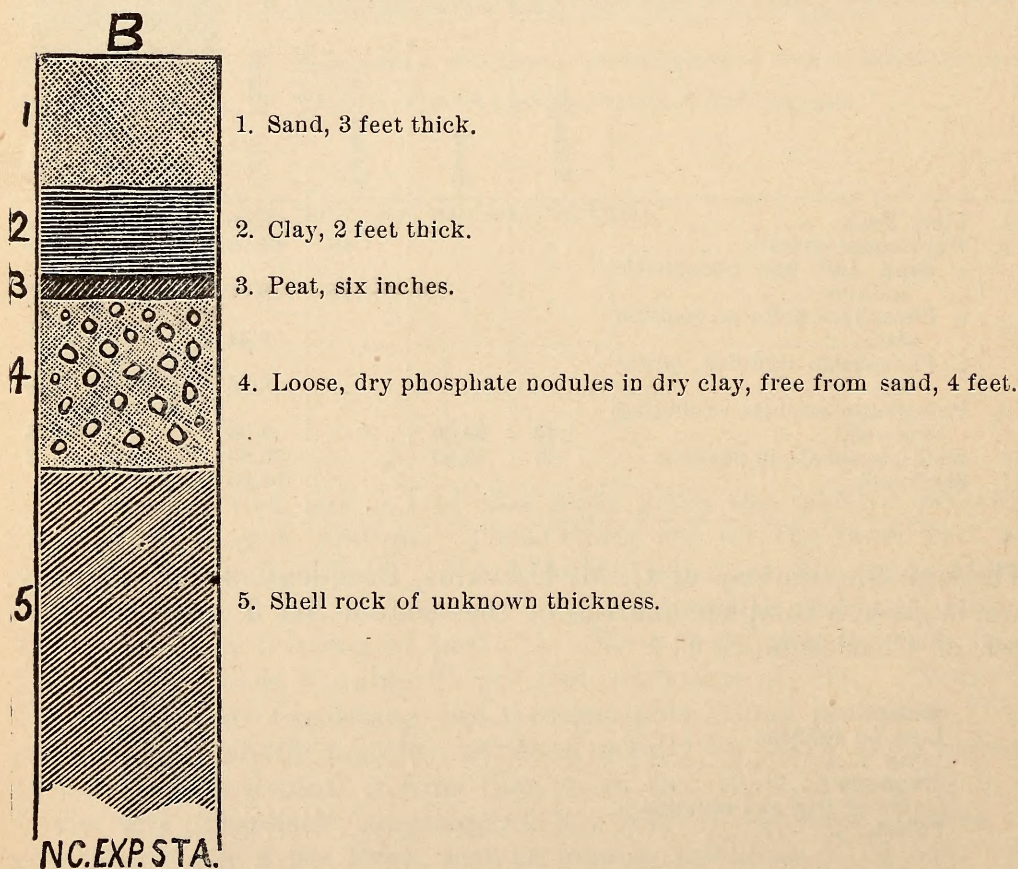
Moisture.....	1.75
Loss on ignition.....	4.30
Lime.....	27.80
Magnesia.....	.22
Oxide of iron and alumina.....	6.37
Potash.....	1.15

Soda	1.28
Phosphoric acid.....	17.27
Carbonic acid.....	4.00
Sulphuric acid.....	1.46
Silica and sand.....	34.40
Total.....	100.00

Bed B. The portion of the deposit at Castle Haynes to be called in this preliminary report "Bed B," has never been heretofore described, and has only been discovered but a short while. It is situated about 800 feet west of Bed A, and extends, as has been determined up to this time by actual pits dug, 500 yards down Princes Creek and in breadth 100 yards. It is probable that this bed extends southward across the creek. The strata are so nearly alike throughout this area that an ideal section (Section B) will nearly represent the whole area. This bed is as yet not mined for merchantable purposes.

The strata are horizontal as in bed A, but different from the latter in the order of deposition. In bed B, the phosphatic conglomerate (No. 5) of bed A, is wholly wanting, as well as the phosphatic nodules of Nos. 7, 8 and 9, leaving only a small portion of the phosphate of lime existing in bed B., much smaller indeed than is seen in bed A.

IDEAL SECTION OF CASTLE HAYNES DEPOSIT—BED B.



An ideal section of this bed (see Sec. B) will represent an average of 3 feet of sand at the surface, followed by 2 feet of clay, which is underlaid by six inches of peat (3). So far this section is nearly identical with the section of bed A. But instead of having now the hard conglomerate of the latter bed there is a stratum of 4 feet on the average of phosphatic nodules intermingled with dry clay and free from sand. Finally is seen the hard shell rock (5) extending to an unknown depth.

ANALYSIS* OF STRATUM 4, OF BED B.

	Moist- ure.	Potash.	Phos. Acid.	Equiv. to Phos. Lime.
Stratum 4, loose nodules alone.....	1.88	1.05	13.04	28.47

Further study and more extensive examinations of the beds are now in progress, which may effect very materially statements in this preliminary report.

HOME-MADE FERTILIZERS AND COMPOSTS.

It has always been the policy of the Experiment Station to encourage the preserving and utilizing of waste products, which ordinarily, except on well regulated farms, are thrown aside as worthless and are considered troublesome as well. There is no reason why these products should not be preserved and utilized in the form of home-made fertilizers and composts. For this purpose the Station has for years distributed broadcast numerous formulas for composts and mixtures, and in addition has made gratuitous analyses of samples of these mixtures whenever they were sent to it.

The following is a list of such samples with notes of correspondence at the time they were sent. Formulas, with their cost of mixing in some cases, are given. For further details of the construction of compost mixtures and their formulas, together with various practical methods connected therewith, reference is made to Bulletin 61, which will be supplied on application.

*W. P. Frost, Charleston, S. C.

EDGECOMBE CO.—*Dr. A. B. Nobles, Tarboro, N. C.*

(1) Cotton seed,	2,000 bushels
Stable manure,	2,500 bushels
Cow lot manure,	3,500 bushels
Phosphate marl,	100,000 pounds
Kainit,	10,000 pounds
(2) Pure bone meal,	10,000 pounds
Stable manure,	50,000 pounds
Crushed cotton seed,	15,000 pounds
Muriate potash,	1,250 pounds

The first formula is mixed in layers in January and forked over once about March 1st. The second is put up the last of February. Have the heap thoroughly wet and bank up under close, tight house; and cover it over with 4 inches good rich dirt and pack down. If it gets too hot punch holes in heap and pour in water. The phosphate marl is from bed near by and contains a high per cent. of phosphate of lime.

For analyses of these mixtures, see Nos. 4739 and 4740 in Table of Analyses.

In preparing land for cotton broadcast the manure with Kemp's Spreader; then break up and run over with Clark's cutaway harrow; the Acme harrow is then used and finish off with the smoothing harrow.

EDGECOMBE CO.—*Col. Elias Carr, Old Sparta, N. C.*

Woods mould or rich earth,	1,800 pounds,	\$.25
Stable manure,	1,500 pounds,	.50
Lot manure,	2,000 pounds,	.50
Cotton seed or meal (600 pounds seed or 300 pounds meal),		3.00
Kainit,	150 pounds,	.90
Acid phosphate,	300 pounds,	2.40
		<hr/>
		\$7.55

The above is the proper amount for one acre and with the moisture added gives about 8,000 pounds. Thinks best to mix in as large heaps as practicable, not less than enough for 10 acres. Thorough mixing is indispensable.

For analysis of this mixture, see No. 4783 in Table of Analyses.

Gives a guaranteed return of 400 pounds lint cotton with the use of this mixture. The advantage is largely in favor of compost over the manipulated or complete fertilizers. Buys no ammonia, thinking that stable manure and cotton seed furnish a sufficiency for the crop.

CHOWAN CO.—*J. G. Williams, Edenton, N. C.*

Horse manure,	15 cart loads
(or hog manure,	25 cart loads)
Cotton seed,	12 to 15 bushels
Rich ditch bank,	about 3 times bulk of above

About \$10 per acre.

For analysis of this mixture, see No. 4785 in Table of Analyses.

About 2,000 loads are put on 25 acres. The balance of his cotton will be manured with cotton seed meal (250 pounds per acre), which he finds cheaper (costing about \$3 per acre) and just as good as compost for an *immediate* crop. On his corn crop he will put ground cotton seed, 20 bushels per acre.

Finds that red top grass gives fair meadows and rich pasture for an indefinite time.

WILSON CO.—*Dr. A. G. Brooks, Black Creek, N. C.*

(1) Muck,	60 bushels
Stable manure,	30 bushels
Cotton seed,	30 bushels
Kainit,	200 pounds
Acid phosphate,	200 pounds
(2) Muck,	60 bushels
Cotton seed,	30 bushels
Stable manure,	30 bushels
Marl,	50 bushels
Kainit,	200 pounds
(3) Barn yard litter, etc.,	100 cart loads
Cotton seed,	30 bushels
Marl,	60 bushels
Kainit,	400 pounds

(1) and (2) are mixed and applied in the drill in the quantity given above to 1 acre.

With (3) all litter from barn yard and cattle lot and waste products of yard are gathered in a heap about 4 to 6 weeks before applying and mixed with the other ingredients. Apply broadcast at the rate of 100 cart loads per acre.

100 loads of compost are much cheaper than a ton of guano and worth more money.

CARTERET CO.—*J. W. Sanders, Sanders' Store, N. C.*

Stable manure, . . .	12 loads
Green cotton seed, . . .	1,000 pounds

Use at the rate of the above amount per acre. On one acre 20 bushels unleached ashes were added to the above mixture and better results were gotten therefrom than for some years past.

For analysis of this mixture, see No. 4788 in Table of Analyses.

LENOIR CO.—*J. W. Isler, LaGrange, N. C.*

Stable manure, . . .	8 cents per bushel
Cotton seed, . . .	12½ cents per bushel
Cow lot manure, . . .	12 cents per bushel

\$2.30 per ton.

For analysis of this mixture, see No. 4796 in Table of Analyses.

Thinks farmers should put manure in the ground at least six inches deep, turn over about 6 inches, then run a subsoil plow in the same furrow as deep as the team can pull it.

BERTIE CO.—*A. T. Liverman, Roxobel, N. C.*

Cotton seed, . . .	30 bushels
Acid phosphate, . . .	200 pounds
Kainit, . . .	100 pounds
Stable manure, . . .	30 bushels

Mix the acid phosphate and kainit well and spread over the seed, then put on the manure and continue the layers until enough is made. The sample sent the Station contains also 200 pounds per acre of a superphosphate which was mixed with the manure when dug up and hauled out for distribution.

For analysis of this mixture, see No. 4817 in Table of Analyses.

Three thousand pounds are required per acre.

EDGECOMBE CO.—*J. C. Powell, Tarboro, N. C.*

Good dirt, . . .	10 loads
Lot manure, . . .	20 loads
Acid, . . .	300 pounds
Kainit, . . .	150 pounds

Level the dirt down to about 4 inches in depth; on this haul manure, mixing with it the acid and kainit, all thoroughly wet.

For analysis of this mixture, see No. 4820 in Table of Analyses.

Apply the above amount to one acre.

WILSON CO.—*H. F. Freeman, Taylor, N. C.*

Stable manure, . . .	30 bushels
Cotton seed, . . .	30 bushels
Acid phosphate, . . .	800 pounds
Kainit, . . .	200 pounds

Four tons of this mixture cost \$43, without the stable manure.

"Put down a layer of manure 4 or 6 inches deep and then spread 30 bushels cotton seed evenly over the manure and have two hands to rub the seed while water is thrown over the seed until they are thoroughly wet. On the seed spread 800 pounds acid phosphate and over this 200 pounds kainit." Then commencing with manure another set of layers can be added, and so on. Let this stand about 4 months, when it is cut down and thoroughly mixed and put back in a rail pen which should have been provided in the beginning. Use 400 to 600 pounds per acre.

For analysis of this mixture, see No. 4822 in Table of Analyses.

Likes compost very much and thinks that it improves both cotton and corn.

CUMBERLAND CO.—*G. W. Lawrence, Fayetteville, N. C.*

Cotton seed meal, . . .	1 part
Poultry dung, . . .	2 parts
Acid phosphate, . . .	2 parts

Mix well together. Early in the spring, all the stable and lot manure is hauled out and put into furrows, where the crop is to be grown, and covered with a single furrow. At planting time the manured furrow is opened and the above mixture drilled in. Saves and buys all ashes possible and uses them, in addition to the above mixture, on such crops as require a greater amount of potash.

For analysis of this mixture, see No. 4744 in Table of Analyses.

Thinks that this method is preferable to the compost heap, for you have better control of the ingredients than if they were in the compost heap, besides it saves time and labor. Stable and lot manure are more lasting than the more concentrated fertilizers, and the good effects are seen for several years.

WAKE CO.—*C. N. Allen, Auburn, N. C.*

Scrapings, 1 layer 6 inches thick.
Manure, 1 layer $1\frac{1}{2}$ inches thick.
Scrapings, 1 layer 3 inches thick.
Cotton seed, 1 layer $\frac{3}{4}$ inch thick.

Leave a pile of scrapings at each heap sufficient to cover it 4 inches deep and proceed evenly along the field in this way until it rains sufficiently to wet the seed on the heap thoroughly. As soon as sufficiently dry to haul into field again turn back on same heap as follows :

Manure, 1 layer 1 inch thick.
Scrapings, 1 layer 2 inches thick.
Cotton seed, 1 layer $\frac{1}{2}$ inch thick.

Again leave a pile of scrapings sufficient to cover the heap about 2 inches, which is used to finish off the heap as soon as sufficiently wet. This mode insures moisture and saves hauling water. On slow red lands use horse manure, and cow manure on gray, quick land.

For analysis of this mixture, see No. 4749 in Table of Analyses.

FRANKLIN CO.—*Arthur Arrington, Louisburg, N. C.*

Uses Furman's Formula as follows: Mix 200 pounds acid phosphate and 100 pounds kainit thoroughly and scatter evenly over the manure; next distribute evenly the cotton seed, over which spread the rest of the acid phosphate and kainit. This heap should be covered well with rich dirt. If more than above amount is made, keep on in same way and cover with dirt when finished.

Chemicals and cotton seed which enter into a ton are less than \$10. Manure and manipulation of compost and expense of bought ingredients to be all told when listed in the field are \$12.50 per ton.

For analysis of this mixture, see No. 4794 in Table of Analyses.

Finds the compost so satisfactory that he will continue its use. His tenants are enthusiastic converts to the gospel of composting.

HARNETT CO.—*J. C. Williams, Winslow, N. C.*

Horse stable manure,	.	.	.	30 bushels
Acid phosphate,	.	.	.	200 pounds
Kainit,	.	.	.	100 pounds
Cotton seed,	.	.	.	30 pounds

Weighs about one ton.

Commence first with the manure and proceed with the second layer, finishing according to above formula. Mix the acid phosphate and kainit thoroughly and put it on, making one layer.

For analysis of this mixture, see No. 4797 in Table of Analyses.

MECKLENBURG CO.—*Wm. E. Ardrey, Pineville, N. C.*

(1) Stable manure,	.	.	.	400 pounds
Lot manure,	.	.	.	400 pounds
Acid phosphate,	.	.	.	200 pounds
(2) Stable manure,	.	.	.	400 pounds
Lot manure,	.	.	.	300 pounds
Acid phosphate,	.	.	.	200 pounds
Kainit,	.	.	.	100 pounds

Place in alternate layers and then mix well and press together; if not wet enough, moisten well.

(3) Cotton seed,	.	.	.	300 pounds
Acid phosphate,	.	.	.	200 pounds

The seed is thoroughly wet and rolled in the acid and then well sheltered and allowed to stand in a heap before applying. Acid phosphate costs \$15.25 per ton; the stable manure nothing, only littering the stables, which is very trifling. For analyses of these mixtures, see Nos. 4766, 4767 and 4768 in Table of Analyses.

According to his experience composts give better results than commercial fertilizers. Tries to feed all the cotton seed possible in order to convert them into manure. Thinks that in compost, peas and clover lies the future hope and prosperity of our farmers.

ANALYSES OF HOME-MADE COMPOSTS.

The difficulty in procuring fair and average samples of these mixtures was recognized from the start. Great care was, however, taken, and while the analyses may not entirely represent the whole mass yet they may at least encourage other farmers to save and utilize the otherwise waste products.

In the following table can be seen analyses of the mixtures recorded on the preceding pages. The analyses were made on the air-dried sample and these determinations were calculated back to the original sample as first received. The valuation is inserted for each of these bases, that of the air-dried, and that of the original sample, using the figures for comparative valuations as with commercial fertilizers this season (1889), at the seaboard, viz., for available phosphoric 7 cents per pound, for ammonia 17 cents per pound, and for potash 6 cents per pound. Seaboard prices are given on account of the great difficulty in fixing correct interior rates. The valuations are therefore more of comparative than of intrinsic value. No account (except where stated) is taken of the insoluble phosphoric acid in the mixtures, though undoubtedly it will prove of some value owing to the presence of the quantity of organic matter in the mixtures, which by its action will aid in changing the insoluble phosphate to more available forms. For estimation of value, reference should be made to the air-dried mixture, for the presence of so much water in the original sample—while it gives weight, yet cannot be said to be an item of expense.

ANALYSES OF HOME-MADE MIXTURES.

Station No.	RECEIVED FROM.	ORIGINAL SAMPLE.										AIR-DRIED SAMPLE.									
		Moisture.	Vol. and Organ. Matter.	Sand and Insol. Matter.	Avail.		Insol. Phosphoric Acid.	Ammonia.	Potash.	Value per Ton.	Moisture.	Vol. and Organ. Matter.	Sand and Insol. Matter.	Avail.		Insol. Phosphoric Acid.	Ammonia.	Potash.	Value per Ton.		
					Phos. Acid.	Total Phos. Acid.								Phos. Acid.	Total Phos. Acid.						
																				Sol.	Rev.	Sol.	Rev.
EASTERN DISTRICT.																					
4739	Dr. A. B. Nobles, Tarboro	67.60	13.08	11.03	1.39	1.23	1.33	.77	.64	\$ 7.05	4.72	38.46	32.43	4.08	3.62	3.90	2.26	1.89	\$20.73		
4740	Dr. A. B. Nobles, Tarboro	52.15	14.21	29.52	.30	.14	.32	.31	.32	2.05	3.70	28.60	59.40	.60	.28	.65	.63	.65	4.15		
4783	Col. E. Carr, Old Sparta	36.82	11.20	46.34	.51	.85	.14	.26	.38	3.24	3.09	18.41	71.08	.78	.19	.22	.40	.59	3.42		
4784	W. R. Capehart, Avoca	40.55	10.97	45.60	.18	.....	.26	.31	.23	1.58	2.77	17.95	74.58	.29	.....	.43	.51	.37	2.48
4785	J. G. Williams, Edenton	41.63	10.48	44.60	.16	.....	.38	.37	.16	1.67	3.06	17.41	74.07	.26	.....	.63	.61	.26	2.75
4786	Dr. A. G. Brooks, Black Creek ..	38.41	24.22	21.02	1.22	.55	.75	.38	1.19	5.20	7.91	36.22	46.39	1.83	.83	1.09	.57	1.78	7.80		
4788	J. W. Saunders, Saunders' Store.	42.34	13.74	37.53	.33	.27	.11	.35	.36	2.46	5.02	22.64	61.82	.55	.45	.18	.57	.59	4.05		
4796	J. W. Isler, LaGrange	22.16	14.56	55.98	.80	.41	.21	.33	.48	3.39	2.25	18.29	70.30	1.00	.51	.27	.42	.60	4.26		
4817	A. T. Liverman, Roxobel*	26.72	13.51	41.83	.....	.....	2.53	.58	.80	6.47	6.40	17.25	53.43	.....	.....	3.22	.74	1.02	8.25
4820	J. C. Powell, Tarboro*	55.26	9.28	30.35	.....	.....	.74	.30	.47	2.62	4.28	19.86	64.94	.....	.....	1.59	.64	1.01	5.65
4822	H. F. Freeman, Taylor	38.40	15.36	22.66	.....	.....	3.80	.51	.86	8.09	4.34	23.85	44.51	.....	.....	5.87	.79	1.33	12.50
CENTRAL DISTRICT.																					
4744	G. W. Lawrence, Fayetteville* ..	24.28	33.70	12.61	Total Phos.		7.39	.61	1.38	14.08	6.11	41.78	15.63	Total Phos.		9.16	.76	1.71	17.46		
4749	C. N. Allen, Auburn	26.69	8.21	61.55	.21	.....	.60	.28	.25	1.55	1.22	11.06	82.94	.28	.....	.81	.38	.34	2.09
4750	C. N. Allen, Auburn	30.61	9.05	57.36	.16	.....	.28	.28	.18	1.39	1.29	12.88	81.59	.23	.....	.40	.41	.25	2.02
4751	C. N. Allen, Auburn	14.13	5.33	78.57	.15	.....	.43	.18	.22	1.09	.60	6.17	90.94	.18	.....	.50	.21	.25	1.27
4794	Arthur Arrington, Louisville ..	.....	.....	.....	.....	.....	.....	.....	.....	.....	4.84	20.27	61.46	.24	.79	.20	.38	.71	3.59
4797	J. C. Williams, Winslow	47.37	9.12	35.18	.65	.30	.12	.16	.41	2.37	3.56	16.72	64.46	1.19	.55	.22	.30	.75	4.36		
WESTERN DISTRICT.																					
4766	W. E. Ardrey, Pineville	57.33	18.65	19.30	.32	.....	.53	.49	.52	2.74	5.10	41.48	42.92	.70	.....	1.18	1.09	1.16	6.08
4767	W. E. Ardrey, Pineville	64.24	20.66	9.44	.49	.14	.54	.57	.58	3.52	6.69	53.91	24.64	1.29	.36	1.42	1.48	1.50	9.14		
4768	W. E. Ardrey, Pineville	53.76	21.80	16.53	1.22	.51	.39	.69	.46	5.32	4.30	45.12	34.22	2.48	1.05	.82	1.34	.95	10.64		

*In these samples, owing to lack of data, the total phosphoric acid is classed as available.

COTTON SEED AND TOBACCO PRODUCTS, ETC.

The following analyses of the products of cotton seed and tobacco will illustrate the value of these materials which often-time are allowed to go to waste. Samples of other materials were also sent to the Station, the analyses of some of which are included in the table.

ANALYSES OF COTTON SEED PRODUCTS, ETC.

Station No.	NAME.	SENDER AND ADDRESS.	Moisture.	Vol. or Organ. Matter.	Ash or Mineral Matter.	Phosphoric Acid.	Equiv. to Phos. of Lime.	Nitrogen.	Equivalent to Ammonia.	Potash.
4708	Cotton seed meal,	W. G. Upchurch, Raleigh, N. C.....	.....	.....	.....	.....	.....	7.18	8.72	.....
4676	Cotton seed meal, (supposed to be adulterated but was not).	Jas. P. McRae, Stewart's Station, N. C.....	.....	.....	.....	.....	.....	6.74	8.18	.....
4833	Cotton seed meal,	Experiment Station, Raleigh, N. C.....	.....	.....	.....	.86	1.87	8.70	10.56	1.54
4791	Cotton seed meal (no adulteration).	J. H. B. Stevens, Ashpole, N. C.....	.....	.....	.....	.....	.....	7.17	8.70	.....
4709	Cotton seed hull ashes	W. G. Upchurch, Raleigh, N. C.....	.....	.....	.....	.....	.....	.....	.....	31.09
4672	Muriate of Potash (equiv. to 78.70 per cent.).	Wallace & Carr, Wallace, N. C. ....	.....	.....	.....	.....	.....	.....	.....	49.72
4779	Nitrate and Sulphate of Potash and Ammonia...	Gardner & Chapman, Maple Cypress, N. C..	.....	.....	.....	.....	.....	12.54	15.22	4.61
4769	Calcined Bone....	J. G. Williams, Edenton, N. C.....	.....	.....	.....	31.43	68.63	.415	.50	.....
4770	Extra fine bone meal	P. M. Wilson, Raleigh, N. C.....	.....	.....	.....	22.29	48.67	3.44	4.18	.....
4860	Swamp muck....	Gen. W. P. Roberts, Raleigh, N. C.....	1.82	7.67	85.64	.....	.....	.20	.24	.....
4985	Muck.....	Alston Grimes, Washington, N. C.....	50.91	38.41	6.15	.....	.....	1.295	15.75	.....
4941	Tob. stems No. 1..	W. B. Ferrell, Durham, N. C.....	.....	.....	.....	.76	1.66	.83	1.01	3.188
4942	Tob. stems No. 2..	" " " " " "	.....	.....	.....	.56	1.23	1.99	2.42	3.832

POTABLE WATERS.

Samples of drinking waters have been sent to the Station and have

been analyzed during the past year. Some of the results are recorded in the following table. It must be remembered that these samples are in most cases suspected waters, and, of course, do not represent the general quality of potable waters in use in the State.

The following explanation of water examinations taken from an article in BULLETIN 58, by R. G. Grissom, then Assistant Chemist, will explain the terms used in the analyses:

"Injurious substances to be looked for come under two classes—mineral and organic, the latter embracing noxious microscopical germs. Almost all waters contain some mineral matters, such as lime, magnesia, soda and iron, which in small amounts are considered entirely harmless. On the other hand, lead, copper or arsenic in the smallest traces should call for an unconditional condemnation of the water. Organic contamination may come from (1) decaying animal matter, as from sewage, sinks, slaughter-houses or filthy barn-yards, or from (2) decaying vegetable matter, and these two are common sources of annoyance.

"The presence of organic matter is detected by the amount of gaseous ammonia in solution, which is readily distilled off and determined as 'Free Ammonia,' and by the 'Albuminoid Ammonia,' which comes from the nitrogen of the organic matter being reduced to ammonia by chemical agencies. In these analyses all microscopical examination for Bacteria and other organisms has been omitted.

"The interpretation of the results is as follows:

"TOTAL SOLIDS.—Solid residues on evaporation, which do not exceed 30 or 40 grains per gallon, afford no reason for rejecting the water for domestic use, unless containing some deleterious mineral matters.

"CHLORINE.—The amount of Chlorine, if showing common salt (Sodium Chloride) is, of itself, a matter of very little importance; but in large amounts, more than 5 grains per gallon is often indicative of sewage contamination, and with more than 0.1 part per million of Free Ammonia and more than 0.1 part of Albuminoid Ammonia should cause the water to be condemned.

"HARDNESS.—This will be expressed in the number of grains per gallon of Carbonate of Lime, or its equivalence in other salts, as shown by the precipitating with soap before a lather can be formed. The amount of Lime or Magnesia has little salutary effect upon the water, though it may render it very disagreeable to the taste.

"FREE AMMONIA.—Very pure water should not run more than 0.02 parts per million of Free Ammonia, but good, safe water may run considerably higher; and water running as high as 0.2 parts per million may be accounted safe, if only a very small amount of Albuminoid Ammonia is present.

"ALBUMINOID AMMONIA.—Water with more than 0.1 part per million of Albuminoid Ammonia, especially with a considerable amount of Chlorine, should be regarded as suspicious. With more than 0.15 parts per million, it should be condemned. Wells are often greatly improved by a thorough cleansing out."

ANALYSIS OF POTABLE WATER.

Station No.	RECEIVED FROM.	GRAIN PER U. S. GALLON.		Hardness Equiv. to Car-bonate Lime.	PARTS PER MILLION.		REMARKS.
		Solids.	Chlorine.		Free Ammonia.	Albuminoid Ammonia.	
4826	J. M. Lawing, Lincolnton, N. C.	12.10	.28	.....	.....	.12	Good, pure water.
4829	J. D. Woody, Wilmington, N. C., (spring)	4.60	1.32	.....	.186	.14	Slight organic contamination,—suspicious.
4849	Thomas H. Haughton, Charlotte, N. C.	3.20	0.50	0.0	0.040	0.110	Slight organic contamination,—somewhat suspicious.
4864	Dr. T. D. Millard, Asheville, City water.	6.25	0.34	0.0	0.026	0.074	Very good, pure water.
4865	“ “ “ “	6.66	0.38	0.5	0.026	0.084	Very good, safe water.
4866	“ “ “ “	25.66	4.50	8.0	0.020	0.084	Good, safe water, but hard.
4867	“ “ “ “	20.80	2.37	8.0	0.050	0.090	Good, safe water, but hard.
4868	“ “ “ “	13.00	1.33	3.0	0.070	0.090	Fair, water,—safe.
4869	“ “ “ “	14.50	2.00	4.0	0.050	0.090	Good, safe water.
4870	“ “ “ “	7.50	0.66	1.0	0.020	0.084	Very good, pure water.
4871	“ “ “ “	13.60	2.08	3.0	0.092	0.104	Slight organic contamination,—suspicious.
4872	“ “ “ “	6.40	0.33	0.5	0.050	0.114	Organic contamination,—somewhat suspicious.
4878	Capitol Well, Raleigh.....	10.00	1.00	3.0	0.040	0.130	Organic contamination,—somewhat suspicious.
4879	Insane Asylum Spring, Raleigh.....	4.40	0.50	2.0	0.050	0.050	An exceedingly pure water.
4880	Rocky Branch, Raleigh.....	4.90	0.50	0.5	0.320	0.290	Greatly contaminated,—very dangerous.
4896	Dr. Eugene Grissom, Raleigh, N. C. (Insane Asylum well near building).	6.66	.85	2.00	.01	0.92	Good, safe water.
4897	Dr. Eugene Grissom, Raleigh, N. C. (Insane Asylum well near boiler house).	11.16	2.00	5.00	.01	.07	Good safe water, but rather hard.
4902	D. Sinclair, Plainview, N. C. (Well 18 feet deep under kitchen porch).	23.16	12.00	3.00	.08	.15	Organic contamination,—dangerous.
4915	J. T. DeBerry, Enfield, N. C. (Spring 3 miles west of Conway, Northampton Co).	8.33	.66	.....	.39	2.00	Organic contamination,—suspicious.
4947	H. B. Battle, Raleigh, N. C. (Well corner Jones and Wilmington Sts.)	31.4	5.2	10.00	.0548	13.68	Organic contamination—somewhat suspicious—very hard.
4998	W. C. Carmichael, Asheville, N. C.	3.35	3.39	.45	.0473	.0998	Good, safe water.

IV. CO-OPERATIVE FIELD WORK.

With the stretch of territory that North Carolina possesses, extending from an elevation of near seven thousand feet at the summits of the Blue Ridge to the Atlantic coast, it is but natural to expect every variety of soil, as well as every condition of climate. Taking these facts in consideration it is easy to see that experimental results of whatever nature, dependent on the soil and climate will vary according to the location of these experiments, and the natural conditions there met with. With widely different area, results recorded in the East where the soil is made up from the denudations of the mountains of the West could not be comparable with results obtained from the soils of older formation. And not only does the locality so affect the soil but affects the climate as well, and these both have a direct bearing on the growth of crops.

It is for this reason that the field work of the Experiment Station at its farm is so hampered. Results obtained at it will only represent this locality with its particular soil and climate. If the same experiments be undertaken elsewhere the results might not accord with this locality, and thus be very erroneous and misleading. The only remedy for this state of affairs is to conduct similar experiments in various portions of the State to see wherein the local conditions affect these results. It is, of course, impossible to put a fully equipped experiment station in every county or even district in the State. The only practical method therefore is to secure the co-operation of reliable farmers who would be willing to conduct these experiments under the direction of the Station, who would work with it in investigating the general questions of economical fertilization, either through the usual method of artificial applications of chemicals and fertilizers or by the more natural plan of restoring fertility by means of green manuring.

As early as December, 1887, the writer urged the establishment of these co-operative field experiments in various portions of the State, and the securing of aid from individual farmers who would see personally that the experiments were made a success. The following extracts from a bulletin at the above date will illustrate what was expected to result from a careful conduct of the work:

"1. It promotes accuracy and scientific research in the examination and observation of the various causes that may affect the growth of the crop. 2. It teaches that the soil and plant must be considered as carefully as to the best method of treatment as cattle and live stock; that to attain the best results, certain conditions must be allowed the growing crop. 3. It shows by the result of the experiment what these conditions are. 4. It stimulates inquiry and acquaints the farmer with the appearance of the various fertilizing ingredients and their action on the plant

and soil. 5. Not only will the farmer who conducts the experiments be interested and instructed, but the influence will be felt by all in the immediate vicinity, who will undoubtedly visit the plots and discuss the results." By co-operating with the local organization of the Farmers' Alliance or Grange, the value of the work will be largely increased.

FIELD EXPERIMENTS.

The object of experiments in the field is to determine practically by results obtained in Nature's laboratory, what course shall be pursued in growing a given crop on a given soil. We have obtained scientific results in the chemical laboratory, but will these results be reached in the field where the conditions are so changed; where the crops are affected by the heat of the sun, the beating of rains and hail, the cool of the night? Besides these meteorological conditions which affect our expectations, there are, in addition, complicated changes, which must necessarily be wrought in the soil by the chemical and mechanical agencies there met with. The conditions are so different therefore that we cannot depend on the result of the artificial laboratory to be entirely what will occur in our natural laboratory—the field. The results of each must be compared and a conclusion reached. Work in the field then is as necessary as the work in the laboratory, and the two should be combined to reap the best results.

Field work of an experimental nature has for its object the analysis of the soil, so that it can be determined what elements are lacking in it necessary for the growth of the plant; and to determine which of these elements singly, or which combination, is especially needed for a certain crop. The former of these results can be obtained from experiments in a single locality, the latter from the results from many localities so combined and studied in connection with each other, that a general opinion can be reached. But will the results of one locality, showing the needs of the soil there, be suitable to another section? If this would be the case, experiments carried on at the Experiment Station would answer the requirements of every other portion of the State. But it is not the case. The nature of the soil varies to such an extent that the result of one set of experiments in one place, no matter how carefully or how scientifically conducted, or how much precision is used, will not be suitable to any other locality. If they would be suitable, this vexing question would be greatly simplified. But the soil is very different and the conditions in respect to the weather are very different. We must, therefore, carry on these experiments in as many different localities as possible, and study each in reference, not only to its own locality, but with other results in other sections, in order to verify them and to be able to generalize with the results.

These experiments are nothing more than an analysis of the soil, using Nature's forces to direct it, instead of the heat of the furnace, the action of acids, and other methods of the chemical laboratory.

THE UNRELIABILITY OF SOIL ANALYSIS BY CHEMICAL MEANS.

It is often thought that a chemical examination of any soil will reveal the true value of the ingredients contained in it. Many consequently have the idea that to analyze the soil chemically, is sufficient to show what elements are present, and how much of these elements can be utilized by the plant in the process of its growth. And further, that by knowing the mineral constituents of the matured plant, and the total amount of these constituents extracted by the crop, it will be an easy step to ascertain what mineral fertilizers are needed to apply to the soil to make up any deficiency caused by their absence from the soil, or to make good what is extracted by the crop.

The fallacy of the reasoning, however, lies in the fact that a chemical examination of the soil, while it does give the total quantity of its constituents, it does *not* give the quantity available to the plant, such as can be utilized by the plant. This fact is all-important, for there may be plant food in abundance in the soil, yet in such a form that it is impossible for the plant to derive any benefit from its presence, though it may lie in intimate contact with its numerous roots. Many of our ordinary feldspathic rocks contain in every 100 lbs. as many as 10 lbs. of potash. Yet these 10 lbs.—almost equivalent to 100 lbs. of Kainit—are in such an insoluble, unavailable form, that they are absolutely unserviceable as plant food, unless by some process of disintegration and decomposition, they may become changed to a form which the plant can utilize.

The thorough chemical examination will give the quantity of potash present, and likewise the quantity of the other chemical elements, but the science of chemistry or plant physiology has not yet devised an exact method for determining the proportion of these constituents, which is available to the needs of the plant, and which can be used by it in its growth. Chemistry is constantly advancing, new theories are brought forward, new methods are studied. It may not be a very distant day before reliable data will be obtained, which will give through chemical investigation, the exact proportion of the total mineral elements present, which will be available to plant growth.

But does a chemical analysis of the soil, no matter with what exactness it is carried out, show with sufficient accuracy the contents of the soil? Can we depend on its results to show with definiteness what fertilizer should be applied to the soil to render it more productive? For this distinct purpose the chemical analysis, always so delicate and accurate, is inadequate. A cubic foot of our average upland soil (from results obtained at the Station in the past) weighs 110 lbs. An acre of this soil, 9 inches deep, weighs 2,835,062 lbs., or a fraction over 1,417 tons. Nine inches is taken as an average depth reached by plant's roots; with many plants the tap root grows much lower than this. The ordinary application of ammoniated fertilizer is 200 to 300 lbs. to the acre. If this application of 300 lbs. is thoroughly mixed with the

soil to the depth of nine inches and an average sample obtained, then by no chemical means, no matter how delicate, can this ammoniated fertilizer be detected; and yet this application changes the yield from an unproductive to a productive one, and draws the line between success and failure. Not only cannot 300 pounds to the acre be detected by chemical means, but it is also the case with 500 pounds, with 1,000 pounds, with one ton, to the acre. It can be seen, therefore, how little can be expected from a chemical analysis of a soil.

But, even supposing this were no objection, and there could in addition be secured a reliable chemical method to give the *available* elements of plant food in the soil, a new difficulty presents itself; and this difficulty—which it may be said is more insurmountable than the first—is that of procuring a reliable sample of soil for chemical examination, such a sample that will represent accurately the field from which it was taken. When it is considered that a single field may contain as many as half a dozen distinct varieties of soil, and a single square rod as many as two or three, it is utter folly to suppose that one sample—considering that it does represent the locality from which it comes—can possibly show the composition of any other portion of the field, or even an average of the whole.

It is seen, therefore, that it would not be wise to depend entirely upon the chemical examination of the soil to guide in the application of fertilizing ingredients. Other methods must be looked to, which, though they may be slow before their object can be attained, yet the results are of more value, and if carefully conducted, are more reliable. Results from the field, therefore, should be procured, and for this purpose the field experiments, with various fertilizers on different crops, were instituted.

DETAILS OF THE FIELD EXPERIMENTS.

The object of these experiments, as has been stated, is twofold. 1st. To analyze the soil and ascertain what in its contents will be useful to the plant. 2d. To discover what elements, or combination of elements, are most necessary to the growth of a certain crop. As nitrogen, phosphoric acid, and potash are most needed by plants, and as these ingredients are liable to be easily exhausted from the soil, it is always the endeavor to supply them, singly or together, in some of their combinations to make good any deficiency. To test this question, these ingredients by ones, twos, or threes, are applied to similar portions of the soil, the crops observed on each, and from the results from these separate portions or plots, it can be decided what ingredients give the best result, or which is the same thing, what ingredient is most needed by the soil. Also by comparing the results from many different localities the elements most needed by the plant can be approximately defined.

The fertilizing ingredients to be added to the plots most correctly and scientifically, should *only* be the ingredients enumerated above, without any admixture of foreign elements; in other words, the purest form of

chemicals which contain *only* what it is desired to use. For, in this case the effect of the application can be ascribed only to the one constituent, without being affected by any of the other foreign elements.

But for many reasons, for these co-operative experiments, it was thought best to choose, instead of pure chemicals, such of the ingredients in common use having a predominance of the fertilizing elements desired. While the results will not be scientifically correct, yet they will be sufficiently accurate to suit the ends of the experiments. Instead, therefore, of using the chemicals, sulphate of ammonia, nitrate of soda, to furnish the nitrogen or ammonia; sulphate of potash to furnish the potash, and so on with other chemicals: acid phosphate, cotton seed meal and kainit have been adopted for the purpose of furnishing phosphoric acid, nitrogen and potash respectively as their predominant elements. They contain as well certain other ingredients in small proportion, which will be referred to later.

FARMERS CONDUCTING EXPERIMENTS.

For the proper persons to carry on these experiments in various portions of the State, the best and most careful farmers were requested to co-operate in the work. Accordingly there were selected men of experience and practical skill, to undertake the work for the advancement of the State's agriculture as well as for their own benefit in a fuller knowledge of the soil of their own land.

The following is a list of these, together with the kind of crop experimented with :

1. John Upton, Camden C. H., Camden county, Pea-nuts.
2. M. W. Ballard, Williamston, Martin county, Spanish Pea-nuts.
3. T. L. Jones, Columbia, Tyrrell county, Potatoes.
4. Dr. R. W. Wooten, Kinston, Lenoir county, Potatoes.
5. Dr. D. Cox, Hertford, Perquimans county, Corn.
6. Jesse B. Stokes, Windsor, Bertie county, Corn.
7. H. Clay Williams, Willeyton, Gates county, Corn.
8. T. L. Jones, Columbia, Tyrrell county, Corn.
9. E. F. Lamb, Elizabeth City, Pasquotank county, Cotton.
10. F. R. Johnston, Plymouth, Washington county, Cotton.
11. Dr. R. P. Thomas, Bethlehem, Hertford county, Cotton.
12. R. D. Lunceford, Smithfield, Johnston county, Cotton.
13. J. W. Bryan, Goldsboro, Wayne county, Cotton.
14. S. Fleming, Washington, Beaufort county, Cotton.
15. P. N. Bray, Tulls, Currituck county, Cotton.
16. W. L. Barlow, Tarboro, Edgecombe county, Cotton.
17. T. L. Jones, Columbia, Tyrrell county, Cotton.
18. W. H. Shields, Scotland Neck, Halifax county, Cotton.
19. J. G. L. Crocker, Seaboard, Northampton county, Cotton.
20. Thos. J. King, Louisburg, Franklin county, Cotton.
21. A. A. Perry, Edenton, Chowan county, Cotton.

PLAN OF THE EXPERIMENTS.

Perhaps the plan of the experiments can better be understood by inserting here a portion of the instructions sent to each experimenter, even at the risk of some repetition of what has already been written.

With these instructions were sent the different fertilizers in numbered bags, carefully weighed by an experienced assistant with standard Fairbank scales, and accurately mixed. The advantage of sending the fertilizing ingredients to the farmers in this way is, that the weighing and mixing, as well as the quality of the fertilizer, can be controlled.

The total weight of fertilizers sent to each experimenter was 662 pounds, divided as follows: 250 pounds of acid phosphate, 220 pounds of cotton seed meal, and 192 pounds of kainit. The application of these ingredients to the various plots can readily be seen from the diagram which accompanied the instructions:

INSTRUCTIONS FOR CONDUCTING EXPERIMENTS WITH VARIOUS FERTILIZING INGREDIENTS ON

OBJECT OF THE EXPERIMENTS.—Is to ascertain the needs of the soil to grow a given crop. To do this, different portions of the soil are treated in different ways by applying various fertilizing ingredients in different proportions.

Phosphoric acid, nitrogen and potash are always needed by plants in their growth, and are always the main constituents we seek to apply in adding artificial manures.

These experiments are intended to show—by observing the increased yield due to the various applications—which of these can be used by the plant from the natural source—the soil, or which must come from an artificial application.

A common belief is that a chemical analysis of the soil will show what constituents are present in the soil, and what are needed by the crop that can be furnished by the soil. This is a mistake. It is true that an analysis shows what is in the soil, but it does not show how much of these ingredients are available to the plant. This can only be determined by a practical experiment. And this work which is to be done is this practical experiment.

FERTILIZING INGREDIENTS USED—Are acid phosphate, cotton seed meal and kainit, since these ingredients furnish the above necessary compounds—phosphoric acid, nitrogen and potash—in cheap and available forms.

Acid Phosphate furnishes the phosphoric acid as phosphate of lime in a soluble and readily available form. It contains also other ingredients—the main one being sulphate of lime, which is formed incidentally in the manufacture of the acid phosphate; this, however, will not to any extent affect the results of these experiments.

Cotton Seed Meal furnishes the nitrogen, or as is generally written, its equivalent in ammonia. It contains also small amounts of phosphate of lime and of potash, but in small proportions; these last will have no material bearing on the experiments.

Kainit is used to furnish the potash. It contains as well, ordinary salt and some magnesia compounds, but these will be disregarded in the experiments, as they affect the results but slightly.

To be absolutely exact, various chemicals should be used to furnish *only* the phosphoric acid, nitrogen and potash required, without any admixture of foreign materials. However, instead of the chemicals, the above fertilizing ingredients are used, as being more readily procurable, and consequently more available for use practically.

EXPERIMENTAL FIELD.

1. *Location* should be as level as possible, and easily accessible to visitors who may wish to notice the progress of the experiments.

2. *Soil* to be of uniform character, and to represent as near as possible the average soil of the county.

3. *Number and Size of Plots.*—Twenty-one plots, the space represented in each plot by the planted rows being exactly one-tenth acre.

TREATMENT OF PLOTS.

1. *Cultivation.*—The whole field, consisting of about $2\frac{1}{4}$ acres (125 yards long and 115 yards wide), should be carefully plowed and harrowed. The cultivation of all the plots both previous and subsequent to planting should be exactly the same, so that the difference in the yield may be entirely due to the application of the fertilizers.

2. *Running of Rows.*—After the whole field is prepared rows should be run four feet apart exactly, as per diagram, extending precisely 121 yards (363 feet) long. Three of these rows will represent a space exactly one-tenth acre. If it is impossible to select a field 121 yards long, half this distance, $60\frac{1}{2}$ yards ($181\frac{1}{2}$ feet) may be used, in which case six (6) rows, four feet apart, must be planted.

3. *Numbering of Plots.*—Shall be numbered to correspond to number in diagram enclosed. These plots of one-tenth acre to be treated differently and the effect of the various applications noted. The diagram which follows illustrates the kind and amount of application to be applied to the numbered plots.

4. *Separation of Plots.*—A vacant row is left between each plot so that the application on one will affect as little as possible the plot on either side. Place stakes at each end of every 4th row, as per diagram, to mark off the separate plots. The dividing line will thus be this 4th row, and there will be *three rows* between these lines, and on these three rows the contents of the bag (of that number) is to be applied. The space between these lines are therefore slightly over one-tenth acre; but the space taken up by rows 4 feet apart and 121 yards long (or 6 rows 4 feet apart and $60\frac{1}{2}$ yards long) is exactly one-tenth acre. The vacant row marking the dividing line causes the actual space to be somewhat more than one-tenth acre.

5. *Fertilizing Ingredients for the Plots.*—The contents of the numbered bags are to be applied to the corresponding plots. These contents have been accurately weighed and carefully mixed. If so desired the tags on bags can be used in the field to designate the plots and the treatment. Two plots are to be treated with *stable manure*, as per diagram, to test the result of this application. This manure, of course, we cannot send you. Please procure it of good quality and well rotted. Instead of the stable manure application, home-made compost may be substituted. Other plots may be added, on which any desired application may be tested. Three of the plots have nothing added to them, so that the average yield with no fertilizer can be seen, and the effect of the different applications more readily traced.

It will be noticed that the plots in Section B (11 to 21) have the same mixtures as on Section A (1 to 10) only in smaller proportions. This is done as a check on the results obtained in Section A, and also to ascertain if a smaller addition of fertilizers will give a correspondingly smaller yield.

6. *Application of the Fertilizing Ingredients.*—The details are left to the Superintendent, with the remark that the application should be regular over the whole one-tenth acre in the three (or six) rows mentioned above, and spread as evenly as possible.

7. *Seeding and Subsequent Cultivation.*—Should be carried on in the same way on all parts of both Sections A and B. Where corn is planted, as the rows are four feet apart, the hills might be closer together than usual: So for pea-nuts if this crop is planted.

8. *Appearance of Crop.*—To be reported on blanks furnished.

PRICES AND ANALYSIS OF THE FERTILIZING INGREDIENTS.

The fertilizing ingredients were purchased in Raleigh at the regular market rate for cash. The following shows the prices that were paid, also the analyses of the samples taken after the goods were purchased:

1. Acid phosphate cost \$17.50 per ton, yielded 12.54 per cent. of available phosphoric acid.
2. Cotton seed meal cost \$24.00 per ton, yielded 8.70 per cent. of nitrogen.
3. Kainit cost \$14.00 per ton, yielded 12.64 per cent. of potash.
4. Stable manure, furnished by each experimenter.

DIAGRAM SHOWING EXPERIMENTAL PLOTS AND APPLICATIONS UPON THEM.

PLOTS 121 YDS. LONG.

ONE-TENTH ACRE EACH.

4 FT. BETWEEN ROWS—3 ROWS TO A PLOT

A VACANT ROW MARKS DIVIDING LINE BETWEEN PLOTS.

STAKE	--- ROW --- ROW	Acid Phosphate 40.	PLOT 1	
STAKE	---	Nothing.	PLOT 2	
STAKE	---	Acid Phos. 30. Cotton Seed Meal 15. Kainite 7 lbs.	3	
		C. S, Meal 50.	4	
		Kainite 40 lbs.	5	
		Acid Phos. 30. C. S, Meal 20.	6	
		Acid Phos. 30. Kainite 20 lbs.	7	
		2 2-Horse Loads Stable Manure	8	
		C. S, Meal 25. Kainite 25 lbs.	9	
		Acid Phos. 20. C. S, Meal 20. Kainite 20 lbs.	10	
		Nothing.	11	
		Acid Phosphate 30.	12	
		Acid Phos. 20. Cotton Seed Meal 10. Kainite 5 lbs.	13	
		C. S, Meal 40.	14	
		Kainite 30 lbs.	15	
		Acid Phos. 20. C. S, Meal 10.	16	
		Nothing.	17	
		Acid Phos. 20 Kainite 15 lbs.	18	
		C. S, Meal 20 Kainite 20 lbs.	19	
		Acid Phos. 10. C. S, Meal 10 Kainite 10 lbs.	20	
		1 2-Horse Load Stable Manure	21	

HARRIS 3C.

The ingredients proved to be high grade in each case, the cotton seed meal exceptionally so, and the prices at which they were purchased were comparatively low. The following is a detailed analysis of each ingredient:

1. Acid Phosphate.....	{	Total phosphoric acid	14.20 per cent.
		Insoluble " "	1.48 "
		Soluble " "	10.17
		Reverted " "	2.37
		Available " "	12.54 per cent.
2. Cotton Seed Meal...	{	Total phosphoric acid	0.86 per cent.
		Nitrogen	8.70 "
		Equivalent to ammonia.....	10.56 "
		Potash	1.54 "
3. Kainit	{	Potash	12.64 "
		Equivalent to sulphate potash.....	23.38 "
4. Stable Manure.....	{	Furnished by each Superintendent, consequently no reliable data can be given as to quality.	

AMOUNT OF APPLICATION AND COST ON EACH PLOT AND TO THE ACRE.

The cost and amount of each application to the various plots, and the equivalent to the acre, can readily be seen by referring to the accompanying table. The cost of the fertilizers laid down at the various points will not differ materially from that given in the table, which is the cost at Raleigh, as the freight charges from the seaboard to these points are approximately equivalent to the charges to Raleigh.

RESULTS OF CO-OPERATIVE FIELD EXPERIMENTS, 1888.

The results of the co-operative field work for 1888 is recorded in the pages following. The season was bad for all crops, and the yields were materially affected. The continued rains just following the planting of the crops, were especially unfavorable in nearly every locality. The results are placed in tabulated form for better reference, and calculated in each case to the acre, both as regards application and yield.

In calculating the yield, the following values were taken, in most instances being the same that were used by the experimenters themselves:

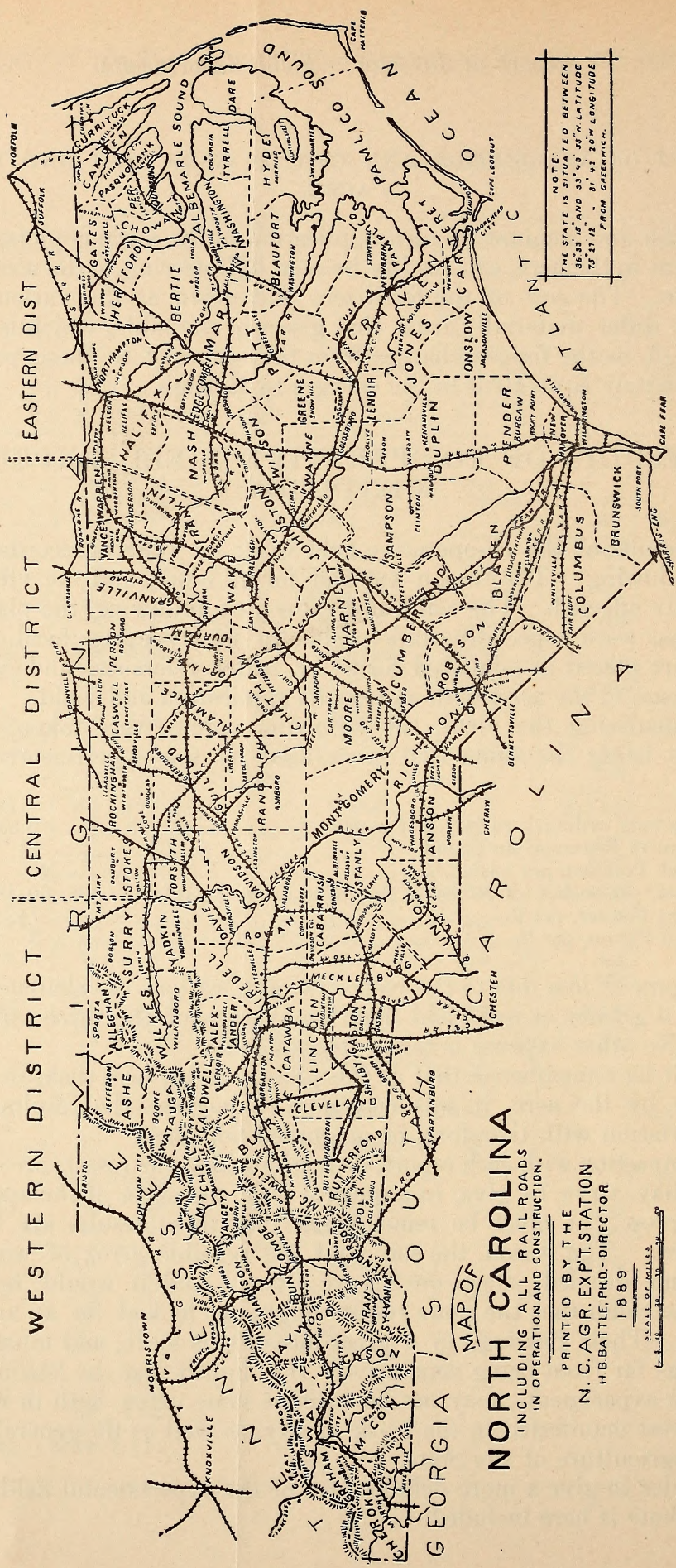
Pea-nuts, ordinary variety, per pound.....	3 cents.
Spanish Pea-nuts, per pound	2½ "
Irish Potatoes, per bushel.....	25 "
Corn, per bushel (of 70 lbs. in ear, or 56 lbs. in grain).....	60 "
Corn Fodder, per lb.....	7½ "
Seed Cotton, per lb.....	3 "

The gain or loss due to the respective applications is calculated on the basis of a greater or less yield than the average of the three unmanured plots. No other expense is taken into account.

It will be remembered that as the plots were $\frac{1}{10}$ acre each, in order to compare by the acre, it was necessary to increase the results tenfold. Any variation will, therefore, be magnified ten times.

In connection with each report, deductions from the results are included, which may serve to give, in a general way, the effect of the application on the crop. It must be remembered that these results are far from conclusive. The season, the soil, and the possible error of work, may have some decided effect on the results. And it would be hardly proper to claim that the same results might be looked for at any other locality. Their bearing, in a great measure, is local; and must be considered as far from being conclusive. It is hoped that the lessons gained from the experiments, may not be without some value, both in respect to the interest manifested in the work locally, as well as the general bearing on the agriculture of the State.

In order to give a more definite idea of the experimental fields, a map of the State is here included.

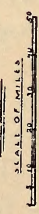


NOTE:
THE STATE IS SITUATED BETWEEN
36° 33' 15" AND 35° 49' 35" N. LATITUDE
75° 21' 12" - 81° 42' 20" W. LONGITUDE
FROM GREENWICH.

NORTH CAROLINA

INCLUDING ALL RAILROADS
IN OPERATION AND CONSTRUCTION.

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H. B. BATTLE, PH.D. - DIRECTOR
1889



1. FIELD EXPERIMENTS WITH PEA-NUTS.

CONDUCTED BY JNO. UPTON, CAMDEN C. H., CAMDEN CO., N. C.

Character of Land:—Light sandy, and gray soil with clay sub-soil. Plots 1–10 were light sandy, planted in corn the previous year, with a handful of cotton seed to the hill. Plots 11–23 were of gray soil with clay sub-soil. All poor land. Planted in cotton the previous year and manured with compost of ditch banks and woods mould—a horse cart-load every 100 yards.

FIELD NOTES:—The directions were carried out fully and two additional plots were laid off and planted in pea-nuts with 40 bushels of lime per acre. The crop was planted May 3d and ploughed on the 22d and 25th. There was too much rain in May, but the crop did well during this month. *June:*—The general condition of crop is good, but weather is unfavorable. 7th, scraped and hoed: 14th, hoed and ran two furrows with turn plow: 19th, ran out the middle of two furrows: 26th, hoed out clean: 29th, ran sweep through furrow. *July:* Crop is good but injured some by cold weather. 10th, ran out middle two furrows: 12th, hoed: 16th, dirted with sweep, two furrows: 25th, laid by with three furrows with turn plow. *August:* Growth very good, but too dry for peas to fill well. 15th, ploughed after hilling and thinks it did them much good as they turned very green in a few days after. *September:* Too much rain; pea-nuts and cotton damaged. *Result:* Pea-nut crop in this section very short this year. Satisfied that it takes lime to fill out the peas.

EXPERIMENTS WITH FERTILIZERS ON PEA-NUTS. JNO. UPTON,
CAMDEN CO:

PER ACRE.

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Gain.	Loss.	
1	400 Acid Phos., containing..	50.16	.....	.....	\$ 3.50	600	18.00	.....	6.50	19
2	None.	.....	.....	.....	.00	700	21.00	.....	.....	11
3	{ 300 Acid Phos., 150 C. S. Meal, } containing	37.62	13.05	11.158	4.91	930	27.90	1.99	.....	4
4	70 Kainit, } 500 C. S. Meal, " }	.....	43.50	7.70	6.00	960	28.80	1.80	.....	5
5	400 Kainit, " }	.....	.....	50.56	2.80	940	28.20	5.40	.....	2
6	{ 300 Acid Phos., 200 C. S. Meal, } "	37.62	17.40	30.80	5.02	910	27.30	1.28	.....	6
7	{ 300 Acid Phos., 200 Kainit, } "	37.62	.....	25.23	4.02	870	26.10	1.08	.....	7
8	20 2-horse l'ds stab. manure,	.....	.....	.....	10.00	700	21.00	.....	10.00	20
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	700	21.00	.....	4.75	17
10	{ 200 Acid Phos., 200 C. S. Meal, } "	25.08	17.40	28.36	5.55	900	27.00	.45	.....	8
11	200 Kainit, } None.	.....	.....	.....	.00	1000	30.00	.....	.....	10
12	300 Acid Phos., " }	37.62	.....	.....	2.62	1150	34.50	.....	2.92	15
13	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	7.86	3.30	1110	33.30	.....	4.80	18
14	50 Kainit, } 400 C. S. Meal, " }	.....	34.80	6.16	4.80	960	28.80	.....	10.80	21
15	300 Kainit, " }	.....	.....	37.02	2.10	1190	35.70	.....	.20	12
16	{ 200 Acid Phos., 150 C. S. Meal, } "	25.08	8.70	15.40	2.95	1550	46.50	8.25	.....	1
17	None.	.....	.....	.....	.00	1320	39.60	.....	.....	9
18	{ 200 Acid Phos., 150 Kainit, } "	25.08	.....	18.96	2.80	1440	42.00	4.40	.....	3
19	{ 200 C. S. Meal, 200 Kainit, } "	.....	17.40	28.36	3.80	1190	35.70	.....	2.90	14
20	{ 100 Acid Phos., 100 C. S. Meal, } "	12.54	8.70	14.18	2.77	1140	34.20	.....	3.37	16
21	100 Kainit, } 10 2-horse l'ds stab. manure,	.....	.....	.....	5.00	1250	37.50	.....	2.30	13
22	40 bushels lime.....	.....	.....	.....	.....	1500	45.00	..	.....	...
23	" " " .....	.....	.....	.....	.....	1550	46.50	.....	.....	...

Deductions from the results:

1. Acid Phosphate alone proved a total failure.
2. Cotton Seed Meal alone in light sandy soil was of little value; on gray soil it proved a total failure.
3. Kainit yielded well on light sandy soil, but on gray soil it did not produce so much.
4. Stable manure has not increased the normal yield, either by a large or moderate application.
5. The best combination for the gray soil seems to be acid phosphate and cotton seed meal.

2. FIELD EXPERIMENTS WITH SPANISH PEA-NUTS.

CONDUCTED BY M. W. BALLARD, WILLIAMSTON, MARTIN CO., N. C.

Character of Land:—Light gray and very poor land; a little moist though high and drained. Sown in peas the year before mixed with Acid Phosphate 25 lbs., C. S. Meal 50 lbs., guano 100 lbs.—broadcasted.

FIELD NOTES:—The instructions were fully carried out. No additional plots were planted. Planted May 2d; transplanted and replanted 20th; hoed and plowed 29th. From 1st to 12th very dry, then for four days very nice showers, ending with heavy rains almost every day. *June*: 7th, hoed and plowed; 25th, plowed. *July*: 15th, hoed and plowed; rather dry for past 20 days. Two years ago 300 loads of marl was piled on one end of Plots 1 and 2 and it has damaged them for about $\frac{1}{5}$ of their distances for growth of peas. Have 10 acres in large peas and they are doing well. Have used on them 4 tons lime, 10 tons ashes, and 200 lbs. per acre of a mixture of cotton seed 100 lbs., acid phosphate 50 lbs., and ground fish 50 lbs. *Result*: Will plant no more Spanish peas. On 10 acres made 1,000 bushels of a certain other kind, and on the land adjoining only 35 bushels per acre of the Spanish peas.

EXPERIMENTS WITH FERTILIZERS ON SPANISH PEA-NUTS. M. W. BALLARD, WILLIAMSTON, MARTIN CO.

PER ACRE.

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Gain.	Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	1320	33.00	11.00	.....	4
2	None.	.....	.....	.....	.00	700	17.50	.....	.....	7
3	{ 300 Acid Phos., 150 C. S. Meal, } "	37.62	13.05	11.158	4.91	1400	35.00	12.59	.....	3
4	{ 70 Kainit, 500 C. S. Meal, } "	.....	43.50	7.70	6.00	900	22.50	.....	1.00	8
5	400 Kainit, "	.....	.....	50.56	2.80	700	17.50	.....	2.80	9
6	{ 300 Acid Phos., 200 C. S. Meal, } "	37.62	17.40	30.80	5.02	1440	36.00	13.48	.....	2
7	{ 300 Acid Phos., 200 Kainit, } "	37.62	.....	25.23	4.02	1480	37.00	14.48	.....	1
8	20 2-horse l'ds stable manure,	.....	.....	.....	10.00	1380	34.50	7.00	.....	5
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	640	16.00	.....	6.25	10
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, } "	25.08	17.40	28.36	5.55	1120	28.00	4.95	.....	6

Deductions from the results:

1. Acid Phosphate alone, and in combination, yielded well.
2. Both Kainit and cotton seed meal yielded badly, proving failures in instances when used alone, or in combination.

3. FIELD EXPERIMENTS WITH IRISH POTATOES.

CONDUCTED BY T. L. JONES, COLUMBIA, TYRRELL CO., N. C.

[Mr. Jones varied the instructions by planting the three rows of each plot in three crops instead of one. He accordingly planted Irish potatoes, corn and cotton on every plot—one row to each. In recording the experiments the results are included in separate tables calculated per acre; it will be remembered therefore that this calculation will magnify any variation THREE times more than those of the other experiment.]

Character of Land.—Gray mixed soil of uniform character. In 1886 planted in corn without manure. In 1887 in cotton (by tenant) with light manuring of common compost, not exceeding 20 bushels per acre, uniformly used.

FIELD NOTES.—The instructions were all carried out except as to length of row—which was 115 yards. Additional plots were laid off but not with the regularity of the others; testing, however, was carried on as far as practicable with other commercial fertilizers and home-made manures upon the various crops. *June*: Crops on these plots considerably in advance of generality of crops in the county. Horse stable manure takes the lead of all manures. *July*: Crops damaged (not seriously) by dry weather. 10th, potatoes worked. Horse stable manure, though greatly adulterated is ahead of anything else. *August*: Dry weather has caused cotton to steadily decline, and the excessive rains lately set in will be a further hindrance to it. *Results*: The year has been unfavorable for crops. The long drouth with heavy rains before and after affected crop. Potatoes were also greatly injured by drouth; field peas in the immediate section was almost a total failure.

EXPERIMENTS WITH FERTILIZERS ON IRISH POTATOES. T. L. JONES,
COLUMBIA, TYRRELL CO.

PER ACRE.

No.	APPLICATION IN POUNDS.	Avail. Phos. Acid.	Nitrogen.	Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Bushels.	Value.	Gain.	Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	135	33.75	5.25	.....	6
2	None.	.....	.....	.....	.00	120	30.00	.....	.....	14
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	37.62	13.05	11.158	4.91	142	35.50	5.59	.....	5
4	500 C. S. Meal, "	.....	43.50	7.70	6.00	142	35.50	4.50	.....	7
5	400 Kainit, "	.....	.....	50.56	2.80	150	37.50	9.30	.....	2
6	{ 300 Acid Phos., 200 C. S. Meal, }	37.62	17.40	3.080	5.02	135	33.75	3.73	.....	8
7	{ 300 Acid Phos., 200 Kainit, }	37.62	.....	25.23	4.02	150	37.50	8.48	.....	3
8	20 2-horse ld's stable manure,	.....	.....	.....	10.00	135	33.75	.....	1.25	17
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	142	35.50	5.75	.....	4
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, }	25.08	17.40	28.36	5.55	165	41.25	10.70	.....	1
11	None.	.....	.....	.....	.00	105	26.25	.....	.....	15
12	300 Acid Phos., "	37.62	.....	.....	2.62	120	30.00	2.38	.....	10
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	25.08	8.70	7.86	3.30	120	30.00	1.70	.....	12
14	400 C. S. Meal, "	.....	34.80	6.16	4.80	120	30.00	.20	.....	13
15	300 Kainit, "	.....	.....	37.02	2.10	120	30.00	2.90	....	9
16	{ 200 Acid Phos., 100 C. S. Meal, }	25.08	8.70	15.40	2.95	105	26.25	.....	1.70	19
17	None.	.....	.....	.....	.00	75	18.75	.....	.....	16
18	{ 200 Acid Phos., 150 Kainit, }	25.08	.....	.....	2.80	90	22.50	.....	5.30	21
19	{ 200 C. S. Meal, 200 Kainit, }	.....	17.40	28.36	3.80	105	26.25	.....	2.65	20
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	12.54	8.70	14.18	2.77	105	26.25	.....	1.52	18
21	102-horse loads stable manure,	.....	.....	.....	5.00	127	31.75	1.75	.....	11

Deductions from the results:

1. Potatoes responded well to all fertilizers, and all combinations with few exceptions.
2. Stable manure did not yield as well as commercial fertilizers, the larger application proving a loss.
3. The larger the application of fertilizers, the larger was the yield.

4. FIELD EXPERIMENTS WITH IRISH POTATOES.

CONDUCTED BY DR. R. W. WOOTEN, KINSTON. LENOIR CO., N. C.

(The same experiments with fertilizers as the foregoing, were tried by Dr. Wooten on Irish potatoes. Unfortunately excessive rains cut down the crop early in the season, followed later by a destructive hail storm, which injured the plants to such an extent, as to render it inadvisable to continue the work. The future records of careful work were accordingly lost).

5. FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY DR. DAVID COX, HERTFORD, PERQUIMANS CO., N. C.

Character of Land:—High, light, loamy soil, planted in pea-nuts the year before, with 1,000 lbs. lime per acre. In 1886 planted in oats with cotton seed meal and acid phosphate. Land quite poor.

FIELD NOTES:—The instructions were carried out except that Plot 21 was not planted. The seed were some ordinary variety of corn and were planted on April 17th. During May the crop was chopped and thinned out without use of a plow, and on top of the row stalks were left 33 inches apart. For three weeks from time of planting it was so cold and there was so much rain that it does not look well. The vacant rows between were cultivated to keep grass down. Plots having Kainit on them do not look so well, owing possibly to rain and cold. No. 8 looks very well. On May 26th cultivator was run on each side and land was put in nice order. *June*: General condition very poor until June 6th, on account of cold and wet. Since then there is quite an improvement. 5th, harrowed between the rows, once in each middle. 6th, run the cotton plow, throwing the dirt to the corn well to the middle. 11th, ran cultivator between rows once, then hoed over. 27th, ran the turn plow twice to the middle, throwing the dirt to the corn, sweeping out the middle with a cotton plow. 28th, removed grass with hoe. Very little improvement in use of acid phosphate. Kainit up to 15th worse than nothing, but since a marked improvement. *July*: Acid phosphate has done but little. *Results*: 100 ears weighed 88 lbs. Cotton seed meal undoubtedly ahead of the rest. Kainit and acid phosphate will not pay to be used. Would have had a good yield but for bud and shatter worms. Some of the plots gave more trouble than others. Fodder worthless on account of continued rain while stripping.

EXPERIMENTS WITH FERTILIZERS ON CORN. DR. DAVID COX,
HERTFORD, PERQUIMANS CO.

PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing..	50.16	.....	.....	\$ 3.50	1540	\$13.20	\$.....	\$ 3.83	12
2	None.	.....	.....	.....	.00	1580	13.56	.....	.....	2
3	{ 300 Acid Phos., } 150 C. S. Meal, } containing	37.62	13.05	11.158	4.91	1700	14.58	.....	3.86	13
4	70 Kainit, "	.....	43.50	7.70	6.00	1950	16.80	.....	2.73	7
5	500 C. S. Meal, "	.....	.....	50.56	2.80	1490	12.78	.....	3.55	11
6	400 Kainit, "	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	{ 300 Acid Phos., } 200 C. S. Meal, } "	37.62	17.40	3.080	5.02	1780	15.24	.....	3.31	10
7	{ 300 Acid Phos., } 200 Kainit, } "	37.62	.....	25.23	4.02	1500	12.84	.....	4.71	18
8	20 2-horse l'ds stab. manure,	.....	.....	.....	10.00	1840	17.78	.....	5.75	20
9	{ 250 C. S. Meal, } 250 Kainit, } containing	.....	21.75	35.45	4.75	1640	14.04	.....	4.24	17
10	{ 200 Acid Phos., } 200 C. S. Meal, } "	25.08	17.40	28.36	5.55	1740	15.00	.....	4.08	15
11	{ 200 Kainit, } None. } "	.....	.....	.....	.00	1430	12.24	.....	.....	3
12	300 Acid Phos., "	37.62	.....	.....	2.62	1530	13.20	.....	2.95	8
13	{ 200 Acid Phos., } 100 C. S. Meal, } "	25.08	8.70	7.86	3.30	1380	11.82	.....	5.01	19
14	50 Kainit, "	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	400 C. S. Meal, "	.....	34.80	6.16	4.80	1790	15.36	.....	2.97	9
15	300 Kainit, "	.....	.....	37.02	2.10	1340	11.46	.....	4.17	16
16	{ 200 Acid Phos., } 100 C. S. Meal, } "	25.08	8.70	1.54	2.95	1460	12.49	.....	3.99	14
17	None. "	.....	.....	.....	.00	1490	14.78	.....	.....	1
18	{ 200 Acid Phos., } 150 Kainit, } "	25.08	.....	18.96	2.80	1660	14.22	.....	2.10	6
19	{ 200 C. S. Meal, } 200 Kainit, } "	.....	17.40	28.36	3.80	1950	16.71	.....	.62	4
20	{ 100 Acid Phos., } 100 C. S. Meal, } "	12.54	8.70	14.18	2.77	1830	15.67	.....	.63	5
	{ 100 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....

Deductions from the results:

1. Applications of every kind proved total losses.
2. The smaller applications, with few exceptions, yield better than large.
3. Either the land was especially rich, or the season an exceptionally unsuitable one for corn.

6. FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY JESSE B. STOKES, WINDSOR, BERTIE CO., N. C.

Character of Land:—Old worn-out piney woods land, with no improvements. Light sandy loam with yellow gravelly subsoil. In corn previous year with small handful of cotton seed to each hill.

PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.				RESULTS.		Rank.
						LBS.		VALUE.		Net Gain.	Net Loss.	
						Fodder.	Corn.	Fodder.	Corn.			
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	190	485	\$ 1.42	\$5.19	\$.....	\$ 4.69	20
2	None.	.....	.....	.....	.00	200	570	1.50	6.10	.....	.....	9
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	37.62	13.05	11.158	4.91	290	810	2.17	8.66	.....	1.88	17
4	500 C. S. Meal, “	.....	43.50	7.70	6.00	380	900	2.85	9.63	.....	1.32	14
5	400 Kainit, “	.....	.....	50.56	2.80	240	555	1.80	5.94	.....	1.86	16
6	{ 300 Acid Phos., 200 C. S. Meal, }	37.62	17.40	3.080	5.02	290	920	2.17	9.84	.....	.51	11
7	{ 300 Acid Phos., 200 Kainit, }	37.62	.....	25.23	4.02	270	740	2.02	7.92	.....	1.88	17
8	25 bushels Cotton Seed,	.....	.....	.....	3.75	320	810	2.40	8.66	.....	.49	10
9	{ 250 C. S. Meal, 250 Kainit, }	.....	21.75	35.45	4.75	330	980	2.47	10.49	.41	.....	5
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, }	25.08	17.40	28.36	5.55	310	970	2.33	10.38	.....	.64	13
11	None.	.....	.....	.....	.00	200	570	1.50	6.10	.....	.....	9
12	300 Acid Phos., “	37.62	.....	.....	2.62	230	460	1.72	4.92	.....	3.78	19
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	25.08	8.70	7.86	3.30	270	790	2.02	8.45	.....	.63	12
14	400 C. S. Meal, “	.....	34.80	6.16	4.80	340	1065	2.55	11.39	1.34	.....	3
15	300 Kainit, “	.....	.....	37.02	2.10	250	620	1.87	6.63	.....	1.40	18
16	{ 200 Acid Phos., 100 C. S. Meal, }	25.08	8.70	1.54	2.95	260	860	1.95	9.20	.40	.....	6
17	None.	.....	.....	.....	.00	210	620	1.58	6.63	.....	.....	8
18	{ 200 Acid Phos., 150 Kainit, }	25.08	.....	18.96	2.80	320	730	2.40	7.81	.39	.....	7
19	{ 200 C. S. Meal, 200 Kainit, }	.....	17.40	28.36	3.80	350	960	2.62	10.27	1.29	.....	4
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	12.54	8.70	14.18	2.77	360	1030	2.70	11.02	3.15	.....	1
21	10 2-horse l'ds stable manure,	.....	.....	.....	5.00	410	1170	3.08	12.52	2.80	.....	2
22	5 bushels Corn Meal,	.....	.....	.....	3.50	230	620	1.72	6.63	.....	2.95	18

FIELD NOTES:—The instructions were fully carried out, except that $2\frac{1}{2}$ bushels cotton seed were used on No. 8 instead of manure, and the land was not harrowed. An additional plot was planted with $\frac{1}{2}$ bushel corn meal as application. The planting was done April 12th, and the seed used were yellow corn from the county. On May 18th the crop was cultivated with the Iron Age cultivator, and on 25th with Stonewall cotton plow. The crop is backward, owing to the cold weather and excessive rain-fall. All of the applications containing Acid Phosphates are doing much better than those without it, stable manure not excepted. The season has been too cold and wet for Kainit, as it contains such a large amount of salt that crops are not benefited by its use, except when moisture is needed. *June*: Crop very much damaged by excessive rains through May and early part of June. 4th and 20th cultivated; 11th and 28th cultivated. *July*: Crop somewhat damaged by present drouth. *August*: General condition of crop poor. Have had a continual drouth since June 27th. Every crop materially damaged. *Results*: Lower part of plot was a little more moist than the upper, consequently it stood the drouth better.

Deductions from the results:

1. The large applications proved failures; the smaller applications somewhat better.
2. Acid phosphate alone in both small and large applications gave losses.
3. The best combination appears to have been a mixture of 100 pounds each of the three ingredients, though this may have been exceptional.

7. FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY H. CLAY WILLIAMS, WILLEYTON, GATES CO., N. C.

Character of Land:—Nos. 11–21 are a little rolling and not as deep as the rest. Nos. 1–10 had sweet potatoes year before and was manured with compost made of woods-dirt and stable manure (1 load manure to 12 of dirt), about 100 loads per acre. In 1886, planted in black peas. Nos. 11–21 treated in same way, except one end was in vegetables in 1887, and had about 800 pounds bone meal per acre in addition.

FIELD NOTES:—The instructions were fully carried out. One additional plot was laid off 10 yards shorter than the others and 20 pounds bone dust applied. The seed used were a mixture from the barn and were planted April 26th. On May 21st it was replanted and a sulky-plow and harrow run between the rows, and grass was cut out with hoes; on 30th a cultivation was made with hoes and sulky-plow. The dry weather at first caused it to come up slowly, and the wet and cold caused bud-worms to destroy about one-half of crop. The corn is growing rapidly on some of the plots, but the Kainit seems to be of no advantage. *June*: The drouth for the past three weeks has checked the growth, but there have been good rains and the crops are doing well; 9th, planted peas in vacant rows; 16th, plowed and worked with hoe; 19th, used cultivator between the rows. Corn is beginning to tassel. *July*: Corn has eared out well; ears are good roasting size and appear to be maturing well. Cotton seed meal seems to be the best fertilizer. Kainit appears to have little advantage. *August*: Crop good; eared out well. Fodder gathered on 30th. Rain prevented weighing each lot separate. *September*: General condition good. *Results*: Housed October 15th.

EXPERIMENTS WITH FERTILIZERS ON CORN. H. CLAY WILLIAMS,
WILLEYTON, GATES CO.

PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	2740	\$23.46	\$.....	\$.38	6
2	None.	.....	.....	.....	.00	2680	22.98	.....	.....	2
3	{ 300 Acid Phos., 150 C. S. Meal, } “	37.62	13.05	11.158	4.91	2940	25 20	.....	.05	5
4	70 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	500 C. S. Meal, “	.....	43.50	7.70	6.00	3140	26.89	55	.....	1
5	400 Kainit, “	.....	.....	50.56	2.80	2760	22.64	.....	.50	8
6	{ 300 Acid Phos., 200 C. S. Meal, } “	37.62	17.40	3.080	5.02	2860	24.49	.....	.87	9
7	200 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	{ 300 Acid Phos., 200 Kainit, } “	37.62	.....	25.23	4.02	2640	22.56	.....	1.80	12
8	20 2-horse l'ds. stab. manure,	.....	.....	.....	10.00	3440	29.40	.....	.94	10
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	2880	24.66	.....	.43	7
10	{ 200 Acid Phos., 200 C. S. Meal, } “	25.08	17.40	28.36	5.55	2600	22.26	.....	3.63	17
11	200 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	None.	.....	.....	.....	.00	2340	20.04	.....	.....	3
12	300 Acid Phos., “	37.62	.....	.....	2.62	2280	19.50	.....	3.46	16
13	{ 200 Acid Phos., 100 C. S. Meal, } “	25.08	8.70	7.86	3.30	2600	22.26	.....	1.38	11
14	50 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	400 C. S. Meal, “	.....	34.80	6.16	4.80	2740	23.76	.....	1.38	11
15	300 Kainit, “	.....	.....	37.02	2.10	2280	19.50	.....	2.94	14
16	{ 200 Acid Phos., 100 C. S. Meal, } “	25.08	8.70	1.54	2.95	2340	20.04	.....	3.25	15
17	None.	.....	.....	.....	.00	2100	18.00	.....	.....	4
18	{ 200 Acid Phos., 150 Kainit, } “	25.08	.....	18.96	2.80	2000	17.10	.....	6.04	20
19	200 C. S. Meal, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
19	200 Kainit, “	.....	17.40	28.36	3.80	2060	17.64	.....	6.50	21
20	{ 100 Acid Phos., 100 C. S. Meal, } “	12.54	8.70	14.18	2.77	2000	17.10	.....	6.01	19
21	100 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	10 2-horse l'ds. stab. manure,	.....	.....	.....	5.00	2460	21.06	.....	4.28	18
22	222 lbs. Bone Dust,	.....	.....	.....	3.33	2444	20.94	.....	2.73	13

Deductions from the results :

1. Applications showed losses in all except one insignificant case.
2. The smaller the application the smaller the yield in excess over unmanured plots.
3. The different previous treatment of the plots undoubtedly had some effect on the yield in causing its variation.

8. FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY T. L. JONES, COLUMBIA, TYKRELL CO., N. C.

[Mr. Jones varied the instructions by planting the three rows of each plot in three crops instead of one. He accordingly planted Irish Potatoes, Corn, and Cotton on every plot—one row to each. In recording the experiment the results are included in separate tables calculated per acre; it will be remembered, therefore, that this calculation will magnify any variation THREE times greater than those of other experiments.]

Character of Land:—Gray mixed soil of uniform character. In 1886 planted in corn without manure. In 1887 in cotton (by tenant) with light manuring of common compost, not exceeding 20 bushels per acre, uniformly used.

PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Ail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3 50	1305	\$ 14.49	\$.....	\$ 3.50	13
2	None.	.....	.....	.....	.00	1305	14.49	.....	.....	1
3	{ 300 Acid Phos., } 150 C. S. Meal, } 70 Kainit, }	37.62	13.05	11.158	4.91	1305	14.49	.....	4.91	15
4	500 C. S. Meal, "	.....	43.50	7.70	6.00	1775	18.02	.....	2.47	9
5	400 Kainit, "	.....	.....	50.56	2.80	1029	11.07	.....	5.42	17
6	{ 300 Acid Phos., } 200 C. S. Meal, }	37.62	17.40	3.080	5.02	1320	14.13	.....	5.36	16
7	{ 300 Acid Phos., } 200 Kainit, }	37.62	.....	25.23	4.02	1305	14.49	.....	4.02	14
8	20 2-horse l'ds. stable manure	.....	.....	.....	10.00	2261	24.21	.....	.28	4
9	{ 250 C. S. Meal, } 250 Kainit, } containing	.....	21.75	35.45	4.75	1775	18.02	.....	1.22	6
10	{ 200 Acid Phos., } 200 C. S. Meal, } 200 Kainit, }	25.08	17.40	28 36	5.55	1029	11.07	.....	8.97	21
11	None.	.....	.....	.....	.00	1305	14.49	.....	.....	2
12	300 Acid Phos., "	37.62	.....	.....	2.62	1305	14.49	.....	2.62	10
13	{ 200 Acid Phos., } 100 C. S. Meal, } 50 Kainit, }	25.08	8.70	7.86	3.30	1567	16 77	.....	1.02	5
14	400 C. S. Meal, "	.....	34.80	6.16	4.80	1575	16.86	.....	2.43	8
15	300 Kainit, "	.....	.....	37.02	2.10	1305	14.49	.....	2.10	7
16	{ 200 Acid Phos., } 100 C. S. Meal, }	25.08	8.70	1.54	2.95	1305	14.49	.....	2.95	12
17	None.	.....	.....	.....	.00	1305	14.49	.....	.....	3
18	{ 200 Acid Phos., } 150 Kainit, }	25.08	.....	18 96	2.80	1042	11.62	.....	5.67	18
19	{ 200 C. S. Meal, } 200 Kainit, }	.....	17.40	28.36	3.80	1042	11.62	.....	6.67	19
20	{ 100 Acid Phos., } 100 C. S. Meal, } 100 Kainit, }	12.54	8.70	14.18	2.77	810	8.67	.....	8.59	20
21	10 2-horse l'ds. stable manure	.....	.....	.....	5.00	1575	16.86	.....	2.63	11

FIELD NOTES:—The instructions were carried out except as to the length of rows, which was 115 yards. Additional plots were laid off but not with the regularity of the others; testing, however, was carried on as far as practicable with other commercial fertilizers and home-made manures upon the various crops. Corn was planted on the 27th of April, and the cultivator run through on May 18th. Corn was not damaged during this month, but cotton is not looking well on account of heavy rains and cold nights. *June*: Crops on these plots considerably in advance of generality of crops in the county. Horse stable manure takes the lead of all manures. Corn worked on the 25th. *July*: Crops damaged, but not seriously, by dry weather. Horse stable manure, though greatly adulterated, is ahead of anything else. *Results*: The year has been unfavorable for crops. Corn was greatly injured by drouth, and field peas in the immediate section were almost a total failure.

Deductions from the results:

1. Applications gave total losses without a single exception.
2. The large application of stable manure secured the best yield of any over the unmanured plots.

SUMMARY OF EXPERIMENTS WITH CORN.

In a separate table is recorded a summary of the experiments with fertilizers on corn; wherein the heavy type expresses the gain, and ordinary type the loss, as compared with unfertilized plots.

A casual glance at the table is sufficient to indicate that all applications, with few insignificant exceptions, proved total losses, nor did larger applications increase the yield proportionately. It would appear that for corn, at least for this season, these soils alone without fertilizers were capable of producing their maximum yield; and that the addition of fertilizers did not increase the yield to a basis approaching a paying one. For the exact cause of this result it would be hazardous to assign any single reason. It is not probable that the unfavorable season was the sole cause, as no doubt this would have affected the unfertilized plots in the same manner. The results recorded show conclusively that, for 1888, fertilization of these four soils for corn proved unnecessary and unremunerative. It is not certain, however, that during successive seasons the results will be the same. Additional investigations can alone settle this point.

SUMMARY OF EXPERIMENTS WITH CORN.

PER ACRE.*

No.	APPLICATION IN POUNDS.	Perquimans Co. High Light Loamy Soil.	Bertie Co. Light Sandy Loam with Yellow Grav- elly Subsoil.	Gates Co.	Tyrrell Co. Uniform Gray Soil.
1	400 Acid Phos.,	\$ 3.83	\$ 4.69	\$.38	\$ 3.50
2	None.	.....	.....	.....	.....
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	3.86	1.88	.05	4.91
4	500 C. S. Meal,	2.73	1.32	.55	2.47
5	400 Kainit,	3.55	1.86	.50	5.42
6	{ 300 Acid Phos., 200 C. S. Meal, }	3.31	.51	.87	5.36
7	{ 300 Acid Phos., 200 Kainit, }	4.71	1.88	1.80	4.02
8	20 2-horse loads stable manure,	5.75	.49†	.94	.28
9	{ 250 C. S. Meal, 250 Kainit, }	4.24	.41	.43	1.22
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, }	4.08	.64	3.63	8.97
11	None.	.....	.....	.....	.....
12	300 Acid Phos.,	2.95	3.78	3.46	2.62
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	5.01	.63	1.38	1.02
14	400 C. S. Meal,	2.97	1.34	1.38	2.43
15	300 Kainit,	4.17	1.40	2.94	2.10
16	{ 200 Acid Phos., 100 C. S. Meal, }	3.99	.40	3.25	2.95
17	None.	.....	.....	.....	.....
18	{ 200 Acid Phos., 150 Kainit, }	2.10	.39	6.04	5.67
19	{ 200 C. S. Meal, 200 Kainit, }	.62	1.29	6.50	6.67
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	.63	3.15	6.01	8.59
21	10 2-horse loads stable manure,	.....	2.80	4.28	2.63
22	5 bushels Corn Meal,	.....	2.95	.....	.....
23	222 lbs. Bone Dust,	.....	.....	2.73	.....

*Heavy type expresses the net gain, and ordinary type the net loss in money value as compared with unfertilized plots, after subtracting cost of application.

†Application of 25 bushels cotton seed, instead of stable manure.

9. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY E. F. LAMB, ELIZABETH CITY, PASQUOTANK CO., N. C.

Character of Land:—Ordinary light loam of about 3 barrels per acre capacity. Planted in corn and cotton the previous year without manure.

RESULTS PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	240	\$ 7.20	\$.....	\$ 12.87	20
2	None.	.....	.....	.....	.00	470	14.10	.....	.....	8
3	{ 300 Acid Phos., } 150 C. S. Meal, } “	37.62	13.05	11.158	4.91	850	25.50	4.02	.....	4
4	70 Kainit, }	.....	43.50	7.70	6.00	590	17.70	.....	4.87	14
5	500 C. S. Meal, “	.....	.....	50.56	2.80	300	9.00	.....	10.37	17
6	{ 300 Acid Phos., } 200 C. S. Meal, }	37.62	17.40	3.080	5.02	770	23.10	1.51	.....	6
7	{ 300 Acid Phos., } 200 Kainit, }	37.62	.....	25.23	4.02	980	29.40	8.81	.....	1
8	20 2-horse l'ds. stable manure	.....	.....	.....	10.00	1100	33.00	6.43	.....	2
9	{ 250 C. S. Meal, } 250 Kainit, } containing	.....	21.75	35.45	4.75	810	24.30	2.98	.....	5
10	{ 200 Acid Phos., } 200 C. S. Meal, }	25.08	17.40	28.36	5.55	640	19.20	.....	2.92	12
11	200 Kainit, }	.....	.....	.....	.00	910	27.30	.....	.....	7
12	None.	.....	.....	.....	.00	910	27.30	.....	.....	7
13	300 Acid Phos., “	37.62	.....	.....	2.62	510	15.30	.....	3.89	13
14	{ 200 Acid Phos., } 100 C. S. Meal, }	25.08	8.70	7.86	3.30	810	24.30	4.43	.....	3
15	50 Kainit, }	.....	34.80	6.16	4.80	270	8.10	.....	13.27	21
16	400 C. S. Meal, “	.....	.....	37.02	2.10	260	7.80	.....	10.87	19
17	300 Kainit, “	.....	.....	.....	2.95	570	17.10	.....	2.42	11
18	{ 200 Acid Phos., } 100 C. S. Meal, }	25.08	8.70	1.54	.00	310	9.30	.....	.....	9
19	None.	.....	.....	.....	.00	310	9.30	.....	.....	9
20	{ 200 Acid Phos., } 150 Kainit, }	25.08	.....	18.96	2.80	380	11.40	.....	7.97	17
21	{ 200 C. S. Meal, } 150 Kainit }	.....	17.40	28.36	3.80	170	5.10	.....	5.27	15
22	{ 100 Acid Phos., } 100 C. S. Meal, }	12.54	8.70	14.18	2.77	460	13.80	.....	5.54	16
23	100 Kainit, }	.....	.....	.....	5.00	670	20.10	.....	1.47	10
24	10 2-horse l'ds. stable manure	.....	.....	.....	5.00	670	20.10	.....	1.47	10

FIELD NOTES:—Instructions carried out. A row $3\frac{1}{2}$ feet between the plots was planted in cornfield peas. The seed were Peterkin, obtained in Raleigh, and seed from the county. Date of planting, May 2d. The only cultivation in May was on the 28th, when the crop was scraped and dirted. The cold and rain turned the cotton red and caused some to die. *June*: Affected by cool and dry weather, and lice; 11th, grassed out; 13th, dirted; 30th, opened the furrows and grassed over; thinned out to two stalks in the hill. *July*: Too dry and cool for cotton; 2d, grassed out; 5th, harrowed on each side with one-horse plow; 25th, hilled up from furrows to row. *August*, Rather cool and dry for cotton. *September*: Still rather cool and dry. *Results*: Rather cool and wet throughout for this crop.

Deductions from the results:

1. Neither acid phosphate, cotton seed meal, or Kainit, when used alone, repaid application, either in large or small amounts.
2. A large application of stable manure resulted in profit, whereas loss followed a small application.
3. In each instance, the complete fertilizer of plots 3 and 13 gave good results.
4. The land fails to respond promptly to the use of fertilizers.

10. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY F. R. JOHNSTON, PLYMOUTH, WASHINGTON, CO., N. C.

Character of Land:—Medium light gray land with good clay subsoil. Peanuts planted the year previous; and before that had been in cotton with 30 bushels cotton seed per acre. As measurements were different from instructions, the results are recorded in the table and calculated to conform to the usual applications and results.

FIELD NOTES:—Plots laid out 123 yards long with a row between of $3\frac{1}{2}$ feet, the land being considered insufficient to have them wider, even with the fertilizer. The seed were ordinary variety and were planted May 2d. On May 29th the crop was well grassed out and sided up. The effect of the weather during this month was good. *June*: Two thorough workings with hoe; plowed. Phosphate proved better where used in excess, and, as on No. 1, is only second to No. 8 with stable manure. *July*: Last plowing was on 27th. Acid phosphate not so good as last reported. Kainit very poor. Crops suffering for rain. *August*: Crop greatly damaged by drouth. County will make only three-fourths crop of cotton throughout. Since planting has been worked three times with hoe and four plowings, when required. Acid phosphate did best early in the season. Kainit does not hold up the crop in dry weather as expected; in fact, all others do better than kainit alone. 4, 8, 9 and 14 are very little different, 8 being not quite as green as others. Probably the best application would be 40 per cent. acid phosphate, 40 per cent. cotton seed meal and 20 per cent. kainit. *September*: Damaged by dry weather, though where cotton seed meal and acid are in excess of kainit, or where the cotton seed meal and acid are used exclusively, it is good: where kainit is used, the cotton opened very little behind. Where the phosphate and meal were used, it opened out finely, much better than where they were used alone. Kainit alone did very little good. *Results*: Cotton crop short in the county. Rice one-eighth crop. Peanuts one-third crop.

EXPERIMENTS WITH FERTILIZERS ON COTTON. F. R. JOHNSTON,
PLYMOUTH, WASHINGTON CO.

PER .917 ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing,	50.16	.....	.....	\$ 3.50	750	\$ 22.50	\$ 9.30	\$...	1
2	None.	.....	.....	.....	.00	30	9.00	.....	.....	18
3	{ 300 Acid Phos., } 150 C. S. Meal, } “	37.62	13.05	11.158	4.91	720	21.60	6.99	....	5
4	70 Kainit, } 500 C. S. Meal, } “	.....	43.5	7.70	6.00	760	22.80	5.10	....	11
5	400 Kainit, } “	.....	.....	50.56	2.80	340	10.20	.....	.90	21
6	{ 300 Acid Phos., } 200 C. S. Meal, } “	37.62	17.40	3.080	5.02	700	21.00	6.28	....	6
7	{ 300 Acid Phos., } 200 Kainit, } “	37.62	.....	25.23	4.02	450	13.50	.....	.22	20
8	20 2-horse loads stable manure,	.....	.....	.....	10.00	750	22.50	2.80	....	14
9	{ 250 C. S. Meal, } 250 Kainit, } containing,	.....	21.75	35.45	4.75	760	22.80	8.35	....	3
10	{ 200 Acid Phos., } 200 C. S. Meal, } “	25.08	17.40	28.36	5.55	700	21.00	5.75	....	8
11	200 Kainit, } None.	.....	.....	.....	.00	270	8.10	.....	....	19
12	300 Acid Phos., } “	37.62	.....	.....	2.62	660	19.80	7.48	....	4
13	{ 200 Acid Phos., } 100 C. S. Meal, } “	25.08	8.70	7.86	3.30	630	18.90	5.90	...	7
14	50 Kainit, } 400 C. S. Meal, } “	.....	34.80	6.16	4.80	780	23.40	8.90	....	2
15	300 Kainit, } “	.....	.....	37.02	2.10	400	12.00	.20	....	16
16	{ 200 Acid Phos., } 100 C. S. Meal, } “	25.08	8.70	1.54	2.95	600	18.00	5.35	....	9
17	None.	.....	.....	.....	.00	400	12.00	.....	....	17
18	{ 200 Acid Phos., } 150 Kainit, } “	25.08	.....	18.96	2.80	590	17.70	5.20	....	10
19	{ 200 C. S. Meal, } 200 Kainit, } “	.....	17.40	28.36	3.80	610	18.30	4.80	....	13
20	{ 100 Acid Phos., } 100 C. S. Meal, } “	12.54	8.70	14.18	2.77	460	13.80	1.33	....	15
21	100 Kainit, } 10 2-horse loads stable manure,	.....	.....	.. .	5.00	660	19.80	5.10	....	12

Deductions from results:

1. Fertilizers paid well with but few slight exceptions.
2. Acid Phosphate alone in large quantity paid better than any other application, and almost as well when using a smaller quantity.
3. The complete fertilizer (Nos. 3 and 13) did well in both applications, the larger, however, giving the best results.
4. Kainit alone did but poorly, possibly resulting from excessive rains of the year.

11. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY DR. R. P. THOMAS, BETHLEHEM, HERTFORD CO., N. C.

Character of Land:—Nos. 1–10, medium gray soil, with clay subsoil; had been cultivated in cotton every year with a small quantity of home-made fertilizer of cotton seed, stable manure, acid phosphate and kainit—about 500 pounds per acre.

Nos. 11–21 were light gray soil, with sandy subsoil; had been cultivated in corn every other year, resting between years; used about 20 bushels cotton seed per acre every year cultivated.

RESULTS PER FIFTEEN-SIXTEENTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing,	50.16	.....	.....	\$ 3.50	520	\$15.60	\$.....	\$2.30	20
2	None.	.....	.....	.....	.00	480	14.40	.....	.....	14
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	37.62	13.05	11.158	4.91	650	19.50	0.19	.....	13
4	{ 500 C. S. Meal, 400 Kainit, }	.....	43.50	7.70	6.00	760	22.80	2.40	.....	10
5	{ 300 Acid Phos., 200 C. S. Meal, 300 Kainit, }	.....	.....	50.56	2.80	600	18.00	.80	.....	12
6	{ 300 Acid Phos., 200 C. S. Meal, 200 Kainit, }	37.62	17.40	3.080	5.02	700	21.00	1.58	.....	11
7	{ 300 Acid Phos., 200 C. S. Meal, 200 Kainit, }	37.62	.....	25.23	4.02	570	17.10	.....	1.32	17
8	20 2-horse loads stable manure,	.....	.....	.....	10.00	750	22.50	.....	1.90	19
9	{ 250 C. S. Meal, 250 Kainit, 200 Acid Phos., }	.....	21.75	35.45	4.75	800	24.00	4.85	.....	7
10	{ 200 C. S. Meal, 200 Kainit, None. }	25.08	17.40	28.26	5.55	750	22.50	2.55	.....	9
11	{ 300 Acid Phos., 200 C. S. Meal, 100 Kainit, }	.....	.....	.....	.00	330	9.90	.....	.....	15
12	{ 300 Acid Phos., 200 C. S. Meal, 100 Kainit, }	37.62	.....	.....	2.62	780	23.40	13.28	.....	2
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	25.08	8.70	7.86	3.30	830	24.90	14.10	.....	1
14	{ 400 C. S. Meal, 300 Kainit, 200 Acid Phos., }	.....	34.80	6.16	4.80	290	8.70	.....	3.60	21
15	{ 300 Kainit, 200 Acid Phos., 100 C. S. Meal, }	.....	.....	37.02	2.10	270	8.10	.....	1.50	18
16	{ 200 Acid Phos., 100 C. S. Meal, None. }	25.08	8.70	1.54	2.95	680	20.40	9.95	.....	5
17	{ 200 Acid Phos., 150 Kainit, 200 C. S. Meal, }	.....	.....	.....	.00	170	5.10	.....	.....	16
18	{ 200 Acid Phos., 150 Kainit, 200 C. S. Meal, }	25.08	.....	18.96	2.80	710	21.30	11.00	.....	3
19	{ 200 C. S. Meal, 200 Kainit, 100 Acid Phos., }	.....	17.40	28.36	3.80	530	15.90	4.60	.....	8
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	12.54	8.70	14.18	2.77	680	20.40	10.13	.....	4
21	10 2-horse loads stable manure,	.....	.....	.....	5.83	750	22.50	9.17	.....	6

FIELD NOTES:—Instructions fully carried out, except that 3 feet 9 inches was distance between rows instead of 4 feet. The seed used were "Little Brown," and were planted April 23d. Land very dry when planted, and no rain of consequence until May 11th, hence cotton did not come up until 19th or 20th, when the weather was cold and wet, causing it to die out badly; was not able to cultivate until 31st, on account of wet, and then too muddy, but grass compelled. *June*: Quality of crop not good on account of coming up too late and being forced to make the first cultivations when too wet; 9th, second cultivation; 20th, third cultivation; 30th, fourth cultivation. Note difference in cotton seed meal alone on the two sections. Rain on 1st, 2d, 3d and 27th. *July*: Cultivated on the 9th, 16th, 20th and 31st. Cotton seed meal stands cool dry weather better than any other application. *August*: Very poor, caused by cool and exceedingly dry weather; 9th, last cultivation. *September*: No rain from 1st Tuesday in July to rainy week in September; 25th, first picking; October 25th, second picking.

Deductions from the results:

1. Fertilizers benefited the crop in both varieties of soil. The light gray soil of Nos. 1-10 was not so responsive to fertilizers as the medium gray soil of Nos. 11-21.
2. Acid Phosphate on the medium gray soil (11-21) uniformly increased the yield.
3. Twenty loads stable manure per acre proved to be too great an application compared with the cost. The yield the following year will no doubt be greatly increased.

12. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY R. D. LUNCEFORD, SMITHFIELD, JOHNSTON CO., N. C.

Character of Land:—About two-thirds of each plot was poor, sandy soil; the remaining was more of a clay soil. The year previous it was planted in corn and peas, with 400 pounds home-made compost per acre. Previous to this no manure at all had been applied.

FIELD NOTES:—Instructions carried out, except that width of rows was 3½ feet instead of 4. Seed were ordinary variety and were planted April 20th and 21st. Chopped and sided up between the 14th and 19th of May. Cool, rainy weather caused bad appearance when first grew up, but up to May 31st it was looking better than any crop in the neighborhood. *June*: 13th, hoed and plowed; 21st, hoed; 26th, plowed. On clay portion of each plot the plants were doing well, better than the sandy portion. *July*: Crop is good, but suffering from drouth; 15th, hoed; 20th, plowed twice to row; 31st, split the middles. Since rain and hot weather no great difference in plots, except with those with stable manure. *August*: Crop is very bad. No rain of any value since last month, and there appears to be no variation between plots; all are burnt up. *Results*: First picking September 17th. Condition of the crop is bad. Owing to much rain cotton is sprouting in the bolls, and badly damaged.

EXPERIMENTS WITH FERTILIZERS ON COTTON. R. D. LUNCEFORD,
SMITHFIELD, JOHNSTON CO,

PER SEVEN-EIGHTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing,	50.16	.....	.....	\$ 3.50	430	\$12.90	.....	\$3.30	20
2	None.	.....	.....	.....	.00	410	12.30	.....	.....	14
3	{ 300 Acid Phos., 150 C. S. Meal, } "	37.62	13.05	11.158	4.91	590	17.70	.09	.....	11
4	{ 70 Kainit, } "	.....	43.50	7.70	6.00	750	22.50	3.80	.....	5
5	500 C. S. Meal, "	.....	.....	50.56	2.80	460	13.80	.....	3.70	21
6	{ 400 Kainit, } "	.....	.....	.....	.....	.....	.....	.....	.....	.....
6	{ 300 Acid Phos., 200 C. S. Meal, } "	37.62	17.40	3.080	5.02	610	18.30	.58	.....	10
7	{ 300 Acid Phos., 200 Kainit, } "	37.62	.....	25.23	4.02	550	16.50	.....	.22	15
8	20 2-horse loads stable manure,	.....	.....	.....	10.00	950	28.50	5.80	...	3
9	{ 250 C. S. Meal, } containing,	.....	21.75	35.45	4.75	590	17.70	.....	.25	16
10	{ 250 Kainit, } "	.....	.....	.....	.....	.....	.....	.....	.....	.....
10	{ 200 Acid Phos., 200 C. S. Meal, } "	25.08	17.40	28.36	5.55	660	19.80	1.55	.....	6
11	{ 200 Kainit, } "	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	None.	.....	.....	.....	.00	430	12.90	.....	.....	12
12	300 Acid Phos..	37.62	.....	.....	2.62	450	13.50	.....	1.82	19
13	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	7.86	3.30	500	15.00	1.00	.....	8
14	{ 50 Kainit, } "	.....	34.80	6.16	4.80	570	17.10	.....	.40	17
15	400 C. S. Meal, "	.....	.....	37.02	2.10	440	13.20	.....	1.60	18
16	{ 300 Kainit, } "	.....	.....	.....	.....	.....	.....	.....	.....	.....
16	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	1.54	2.95	720	21.60	5.95	.....	2
17	None.	.....	.....	.....	.00	430	12.90	.....	.....	13
18	{ 200 Acid Phos., 150 Kainit, } "	25.08	.....	18.96	2.80	480	14.40	1.10	.....	7
19	{ 200 C. S. Meal, } "	.....	17.40	28.36	3.80	530	15.90	.60	.....	9
20	{ 200 Kainit, } "	.....	.....	.....	.....	.....	.....	.....	.....	.....
20	{ 100 Acid Phos., 100 C. S. Meal, } "	12.54	8.70	14.18	2.77	610	18.30	3.83	.....	4
21	{ 100 Kainit, } "	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	10 2-horse loads stable manure,	.....	.....	.....	5.00	850	25.50	7.80	.....	1

Deductions from the results:

1. Stable manure application gives better returns than any fertilizers, ten loads per acre being preferable to twenty.

2. Kainit alone was not profitable, being most probably affected by the extreme wet weather during the early part of the season.

3. Acid Phosphate alone is invariably unprofitable.

4. A mixture of Acid Phosphate and cotton seed meal appears to pay best.

13. **FIELD EXPERIMENTS WITH COTTON.**

CONDUCTED BY J. W. BRYAN, GOLDSBORO, WAYNE CO., N. C.

Character of Land:—Very old land, dark, approaching black, rather sandy, with close, dark subsoil at six inches, and then a grayish sandy soil. In 1886 in corn and peas without manure, except in the hill after corn was up. In 1887 in corn and peas without manure, followed by peas broadcast without manure.

PER TWO-THIRDS ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing,	50.16	.....	.....	\$ 3.50	125	\$ 3.75	\$.....	\$ 4.25	19
2	None.	.....	.....	.....	.00	40	1.20	.....	.....	13
3	{ 300 Acid Phos., 150 C. S. Meal, } " 70 Kainit,	37.62	13.05	11.158	4.91	190	5.70	.....	3.71	17
4	500 C. S. Meal, " 400 Kainit,	.....	43.50	7.70	6.00	65	1.95	.....	8.55	21
5	400 Kainit, " 300 Acid Phos.,	.....	.....	50.56	2.80	265	7.95	.65	.....	9
6	{ 200 C. S. Meal, } " 200 Acid Phos.,	37.62	17.40	3.080	5.02	170	5.10	.....	4.42	20
7	{ 200 C. S. Meal, } " 200 Kainit,	37.62	.....	25.23	4.02	310	9.30	.78	.....	8
8	20 2-horse l'ds. stable manure,	.....	.....	.....	10.00	450	13.50	.....	1.00	14
9	{ 250 C. S. Meal, } containing 250 Kainit,	.....	21.75	35.45	4.75	380	11.40	2.15	.....	6
10	{ 200 Acid Phos., } " 200 C. S. Meal,	25.08	17.40	28.36	5.55	480	14.40	4.35	.....	3
11	{ 200 Kainit, } " 200 Acid Phos.,	.....	.....	.....	.00	270	8.10	.....	.....	11
12	None.	.....	.....	.....	2.62	390	11.70	4.58	.....	2
13	{ 200 Acid Phos., } " 100 C. S. Meal,	25.08	8.70	7.86	3.30	430	12.90	5.10	.....	1
14	{ 50 Kainit, } " 400 C. S. Meal,	.....	34.80	6.16	4.80	215	6.45	.....	2.85	16
15	300 Kainit, " 200 Acid Phos.,	.....	.....	37.02	2.10	350	10.50	3.90	.....	4
16	{ 100 C. S. Meal, } " 100 C. S. Meal,	25.08	8.70	1.54	2.95	310	9.30	1.85	.....	7
17	None.	.....	.....	.....	.00	140	4.20	.....	.....	12
18	{ 200 Acid Phos., } " 150 Kainit	25.08	.....	18.96	2.80	330	9.90	2.60	.....	5
19	{ 200 C. S. Meal, } " 200 Kainit,	.....	17.40	28.36	3.80	240	7.20	.....	1.10	15
20	{ 100 Acid Phos., } " 100 C. S. Meal,	12.54	8.70	14.18	2.77	250	7.50	.18	.....	10
21	{ 100 Kainit, } " 10 2-horse l'ds. stable manure,	.....	.....	.....	5.00	180	5.40	.....	4.10	18

FIELD NOTES:—The rows were only 80 yards long, but in other respects everything was as instructed. The vacant rows were planted in dwarf beans. The seed were the Duncan, grown by himself, and were planted May 4th. Chopped and plowed May 28th. The cold nights made some of it die out very badly. *June*: Stand was destroyed and crop seriously damaged by very heavy hail storm June 3d; 8th, chopped; 9th, plowed; 23d, plowed; 29th, hoed. Plots so injured early in month by rains—heaviest ever known here—that there are fears that the experiment will be almost a failure. *July*: General condition good, making good growth and fruiting well, though small for the season; 19th, plowed with sweeps. Work is very interesting and is attracting a great deal of attention. *August*: Suffered severely from drouth since about 10th, and has shed considerably, but still is well fruited; 4th, last plowing with sweeps.

Deductions from the results:

1. The large applications proved not so remunerative as small.
2. Cotton seed meal applications showed losses.
3. Soil was not uniform, as shown by variation in unfertilized plots.
4. The best yields were from plots having all three fertilizing ingredients.

14. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY S. FLEMING, WASHINGTON, BEAUFORT CO., N. C.

Character of Land:—Gray loam with clay subsoil. Four years ago was sown in oats, and pastured with cattle and hogs. Last year was manured with equal parts of C. S. Meal, Acid Phosphate and Kainit—400 lbs. per acre of the mixture.

FIELD NOTES:—The length of the rows was 70 yards, and width between rows 3 feet. A vacant row was left between the plots. In other respects the instructions were carried out. No additional plots were laid out. The seed were Dixon's Cluster, obtained in the county and planted April 27th. Chopped and sided off May 15th. Put to a stand and sided up May 31st. Heavy showers and hail causes crop to look rather badly for the time of the year. Plot 8 is by far the best; 10 and 3 are looking well, but not much difference between others. *June*: Owing to cold weather the crop is two weeks behind last year; 15th, plowed and hoed; 29th, ditto. *July*: No rain during this month; crop very small—12 to 16 inches high; 16th, hoed and plowed; 30th, sided up. Great difference in the color of the cotton; on plots with C. S. Meal application it is green; on Kainit, yellow. *August*: General condition good; splendid seasons for cotton the last month; weed is smaller than usual, but full of bolls—better than four years. *September*: Cotton poor; damaged considerably by continued showers.

EXPERIMENTS WITH FERTILIZERS ON COTTON. S. FLEMING, WASHINGTON, BEAUFORT CO.

PER .434 ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.			Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
								Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos.,	containing		50.16	.....	.....	\$ 3.50	520	\$ 15.60	\$.....	\$ 9.80	21
2	None.			.....	.....	.....	.00	540	16.20	.....	.....	19
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	"		37.62	13.05	11.158	4.91	950	27.50	.69	.....	12
4	500 C. S. Meal,	"		.....	43.50	7.70	6.00	1010	30.30	2.40	.....	8
5	400 Kainit,	"		.....	.....	50.56	2.80	810	24.30	.....	.40	15
6	{ 300 Acid Phos., 200 C. S. Meal, }	"		37.62	17.40	3.080	5.02	930	27.90	.98	.....	11
7	{ 300 Acid Phos., 200 Kainit, }	"		37.62	.....	25.23	4.02	1020	30.60	4.68	.....	5
8	20 2-horse l'ds. stable manure,			.....	.....	.....	10.00	1400	42.00	10.10	.....	1
9	{ 250 C. S. Meal, 250 Kainit, }	containing		.....	21.75	35.45	4.75	1150	34.50	7.85	.....	3
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, }	"		25.08	17.40	28.36	5.55	1110	33.30	5.85	.....	4
11	None.			.....	.....	.....	.00	800	24.00	.....	.....	18
12	300 Acid Phos.,	"		37.62	.....	.....	2.62	760	22.80	.....	1.72	20
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	"		25.08	8.70	7.86	3.30	810	24.30	.....	.90	16
14	400 C. S. Meal,	"		.....	34.80	6.16	4.80	950	28.50	1.80	.....	9
15	300 Kainit,	"		.....	.....	37.02	2.10	930	27.90	3.90	.....	7
16	{ 200 Acid Phos., 100 C. S. Meal, }	"		25.08	8.70	1.54	2.95	870	26.10	1.25	.....	10
17	None.			.....	.....	.....	.00	850	25.50	.....	.....	17
18	{ 200 Acid Phos., 150 Kainit, }	"		25.08	.....	18.96	2.80	960	28.80	4.10	.....	6
19	{ 200 C. S. Meal, 200 Kainit, }	"		.....	17.40	28.36	3.80	860	25.80	.10	.....	13
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	"		12.54	8.70	14.18	2.77	810	24.30	.....	.37	14
21	10 2-horse l'ds. stable manure,			.....	.....	.....	5.00	1200	36.00	9.10	.....	2

Deductions from the results:

1. The soil responded well to all fertilizers with few exceptions.
2. Acid Phosphate alone was unremunerative.
3. Stable manure proved the best application, the smaller quantity giving relatively better results than the large in comparison with the investment.

16. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY W. L. BARLOW, TARBORO, EDGECOMBE CO., N. C.

Character of Land:—Average soil with mixture of clay and sand; naturally a good cotton soil. Cotton had been planted for several years previous; manured the previous year with guano, 250 lbs. per acre.

PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	500	\$ 15.00	\$.....	\$ 1.45	20
2	None.	.....	.....	.....	.00	430	12.90	.....	.....	17
3	{ 300 Acid Phos., 150 C. S. Meal, } "	37.62	13.05	11.158	4.91	700	21.00	3.14	.....	10
4	{ 70 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	500 C. S. Meal, "	.....	43.50	7.70	6.00	545	16.35	.....	2.60	21
5	400 Kainit, "	.....	.....	50.56	2.80	565	16.95	1.20	.....	13
6	{ 300 Acid Phos., 200 C. S. Meal, } "	37.62	17.40	3.080	5.02	630	18.90	.93	.....	14
7	{ 200 Kainit, }	37.62	.....	25.23	4.02	717	21.51	4.54	.....	7
8	20 2-horse l'ds. stable manure	.....	.....	.....	10.00	1200	36.00	13.05	.....	1
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	890	26.70	9.00	.....	2
10	{ 200 Acid Phos., 200 C. S. Meal, } "	25.08	17.40	28.36	5.55	875	26.25	7.75	.....	4
11	{ 200 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	None.	.....	.....	.....	.00	440	13.20	.....	.....	15
12	300 Acid Phos., "	37.62	.....	.....	2.62	585	17.55	1.98	.....	12
13	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	7.86	3.30	785	23.55	7.30	.....	5
14	{ 50 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	400 C. S. Meal, "	.....	34.80	6.16	4.80	590	17.70	.....	.05	19
15	300 Kainit, "	.....	.....	37.02	2.10	790	23.70	8.65	.....	3
16	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	1.54	2.95	530	15.90	0.00	0.00	16
17	None.	.....	.....	.....	.00	425	12.75	.....	.....	18
18	{ 200 Acid Phos., 150 Kainit, } "	25.08	.....	18.96	2.80	660	19.80	4.05	.....	9
19	{ 200 C. S. Meal, 200 Kainit } "	.....	17.40	28.36	3.80	795	23.85	7.10	.....	6
20	{ 100 Acid Phos., 100 C. S. Meal, } "	12.54	8.70	14.18	2.77	605	18.15	2.43	.....	11
21	{ 100 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	10 2-horse l'ds. stable manure	.....	.....	.....	5.00	740	22.20	4.25	.....	8

FIELD NOTES:—The instructions were carried out. The seed were the Peerless variety and were planted May 3d. On May 29th and 30th the crop was chopped out and sided up. On 23d a very heavy rain which continued until last of month, with exception of a few days. Plot 4 looking badly and had to replant a little. Plot 3 is next best to 8. On 8 used stable manure and cotton seed. *June*: 11th and 12th, sided cotton and split middles second time; too wet to work before. 20th, chopped again and replanted; 21st, sided up and split middle. All crops seriously affected by heavy rains, especially cotton. *July*: Bolling well; good rain on 10th; dry for last 20 days and in need of rain badly; 10th and 11th, sided up, split middle and marked with hoe. *August*: Small weed very dry, but well bolled with a little rust in some sections; 8th, gave it last plowing; wherever meal was used seems to have kept green during all dry weather, especially so when meal alone was used; plot 14 is best bolled. *Results*: Too much drouth followed by too much rain, causing rust and blight. Plots 1, 2, 5 and 7 opened slower than any. Rust took nearly all crops except where there was kainit or no application at all. Thinks best results would have come from cotton seed meal had it not been for excessive rains causing rust.

Deductions from the results:

1. Judged by the yield on the three unfertilized plots, the land is very uniform.
2. Cotton seed meal alone proved unprofitable, and in each case gave losses; when mixed with kainit the yield was very favorable.
3. Kainit alone and in combination gave good yields.
4. Stable manure in large applications on this soil proved very successful, having reached a yield almost *three times* that of unmanured plots.

17. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY T. L. JONES, COLUMBIA, TYRRELL CO., N. C.

[Mr. Jones varied the instructions by planting the three rows of each plot in three crops instead of one. He accordingly planted Irish Potatoes, corn and cotton on every plot—one row to each. In recording the experiment, the results are included in separate tables, and any variation therefrom is magnified THREE TIMES over those of the other localities.]

Character of Land:—Gray soil of uniform character. In 1886 in corn without manure. In 1887 in cotton (by tenant) with light manuring of common compost not exceeding 20 bushels per acre uniformly used. Since the rows are shorter than was specified, the calculations are recorded *per .951 acre* instead of *per acre*.

FIELD NOTES:—The instructions were carried out except as to the length of rows, which was made 115 yards. Cotton was planted on the 27th of April and the cultivators run through on May 18th. Cotton is not looking well on account of the heavy rains and cold nights. *June*: Crops on these plots considerably in advance of generality of crops in the county. Horse stable manure takes the lead of all manures. *July*: Crops damaged by dry weather, but not seriously yet; 13th, cotton worked, will require one more working, but cannot give exact date; horse stable manure, though greatly adulterated, is ahead of anything yet. *August*: Dry weather has caused cotton to steadily decline and the excessive rains lately set in will be a further hindrance. *Results*: The year has been unfavorable for crops; the long drouth, with heavy rains before and after, caused rust in cotton.

EXPERIMENTS WITH FERTILIZERS ON COTTON. T. L. JONES,
COLUMBIA, TYRRELL CO.

PER .951 ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing,	50.16	.....	.....	\$ 3.50	540	\$16.20	\$ 2.67	\$....	6
2	None.	.....	.....	.....	.00	390	11.70	.....	.....	14
3	{ 300 Acid Phos., } 150 C. S. Meal, } "	37.62	13.05	11.158	4.91	390	11.70	.....	2.24	21
4	70 Kainit, }	.....	43.50	7.70	6.00	540	16.20	1.17	.....	11
5	500 C. S. Meal, "	.....	.....	50.56	2.80	450	13.50	1.67	.....	10
6	400 Kainit, "	.....	.....	.....	.....	.....	.....	.....	.....	.....
7	{ 300 Acid Phos., } 200 C. S. Meal, } "	37.62	17.40	3.080	5.02	570	17.10	3.05	.....	5
8	200 Kainit, }	37.62	.....	25.23	4.02	450	13.50	.45	.....	13
9	20 2-horse loads stable manure, containing,	.....	.....	.....	10.00	900	27.00	7.97	...	1
10	{ 250 C. S. Meal, } 250 Kainit, }	.....	21.75	35.45	4.75	540	16.20	2.42	.....	8
11	{ 200 Acid Phos., } 200 C. S. Meal, } "	25.08	17.40	28.36	5.55	600	18.00	3.42	.....	4
12	200 Kainit, }	.....	.....	.....	.00	240	7.20	.....	.....	15
13	300 Acid Phos., "	37.62	.....	.....	2.62	360	10.80	.....	.85	19
14	{ 200 Acid Phos., } 100 C. S. Meal, } "	25.08	8.70	7.86	3.30	480	14.40	2.07	.....	9
15	50 Kainit, }	.....	34.80	6.16	4.80	420	12.60	.....	1.23	20
16	400 C. S. Meal, "	.....	.....	37.02	2.10	360	10.80	.....	.33	18
17	300 Kainit, "	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	{ 200 Acid Phos., } 100 C. S. Meal, } "	25.08	8.70	1.54	2.95	540	16.20	4.22	.....	3
19	None.	.....	.....	.....	.00	240	7.20	.....	.....	16
20	{ 200 Acid Phos., } 150 Kainit, }	25.08	.....	18.96	2.80	390	11.70	.....	.13	17
21	{ 200 C. S. Meal, } 200 Kainit, }	.....	17.40	28.36	3.80	450	13.50	.67	.....	12
22	{ 100 Acid Phos., } 100 C. S. Meal, } "	12.54	8.70	14.18	2.77	480	14.40	2.60	.....	7
23	100 Kainit, }	.....	.....	.....	5.00	720	21.60	7.57	.....	2
24	10 2-horse loads stable manure,	.....	.....	.....	.....	.....	.....	.....	.....	.....

Deductions from the results:

1. Stable manure in both large and small applications yielded better than any fertilizer.
2. Neither acid phosphate, cotton seed meal, or kainit, alone proved remunerative.
3. The best combination appeared to be acid phosphate and cotton seed meal.

18. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY W. H. SHIELDS, SCOTLAND NECK, HALIFAX CO., N. C.

Character of Land:—Gray piney land. In pea-nuts the year previous with a little lime.

PER SEVENTH-EIGHTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3 50	780	\$ 23.40	\$ 4 60	\$	5
2	None.	.....	.....	.....	.00	570	17.10	....	....	11
3	{ 300 Acid Phos., 150 C. S. Meal, } "	37.62	13.05	11.158	4.91	640	19.20	.....	1.01	14
4	70 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
4	500 C. S. Meal, "	.....	43.50	7.70	6.00	640	19.20	.....	2.10	17
5	400 Kainit, "	.....	.....	50.56	2.80	760	22.80	4.20	.....	6
6	{ 300 Acid Phos., 200 C. S. Meal, } "	37.62	17.40	3.080	5.02	630	18.90	.....	1.42	15
7	{ 300 Acid Phos., 200 Kainit, } "	37.62	.....	25.23	4.02	710	21.30	1.98	.....	9
8	20 2-horse p'ds. stable manure	.....	.....	.....	10.00	690	20.70	.....	4.60	20
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	800	24.00	3.95	.....	7
10	{ 200 Acid Phos., 200 C. S. Meal, } "	25.08	17.40	28 36	5.55	810	24.30	3.45	.....	8
11	200 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
11	None.	.....	.....	.....	.00	430	12.90	.....	.....	13
12	300 Acid Phos., "	37.62	.....	.....	2.62	410	12.30	....	5.62	21
13	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	7.86	3.30	550	16.50	.....	2.10	18
14	50 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
14	400 C. S. Meal, "	.....	34.80	6.16	4.80	520	15.60	.....	4.50	19
15	300 Kainit, "	.....	.....	37.02	2.10	840	25.20	7.80	.....	1
16	{ 200 Acid Phos., 100 C. S. Meal, } "	25.08	8.70	1.54	2.95	560	16.80	....	1.45	16
17	None.	.....	.....	.....	.00	530	15.90	.....	.....	12
18	{ 200 Acid Phos., 150 Kainit, } "	25.08	.....	18.96	2.80	790	23.70	5.60	.....	4
19	{ 200 C. S. Meal, 200 Kainit, } "	.....	17.40	28.36	3.80	870	26.10	7.00	.....	2
20	{ 100 Acid Phos., 100 C. S. Meal, } "	12.54	8.70	14.18	2.77	810	24.30	6.23	.....	3
21	100 Kainit, }	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	10 2-horse p'ds. stable manure	.....	.....	.....	5.00	620	18.60	1.70	.....	10

FIELD NOTES:—The rows were only half as long as instructed, but twice as many to the plot. Distance between rows $3\frac{1}{2}$ feet. The seed used were raised by the experimenter and planted on May 5th. Owing to late planting and excessive rains, no cultivation in May. Fine seasons until middle of May, then two weeks of heavy rains damaged all crops. All rivers are over their banks and crops will have to be replanted. *June*: Rain first of month and cool weather at the middle rather damaged the crops; however the last ten days were more favorable; 12th, chopped and plowed; 22d, worked with hoe and plowed; 28th, plowed. *August*: 5th, last plowing; considerable difference in some of plots since last report. *Results*: Wherever the acid phosphate predominated the cotton was hardly damaged by rust and gave largest yield. In early part of season the kainit was behind, but later on wherever it predominated the leaves were green and matured in proportion to amount used, as shown by last picking.

Deductions from the results:

1. Kainit alone and in combination proved a very remunerative application, showing that it acted as a rust preventive or that the soil for this year was in need of potash.
2. The yield from cotton seed meal alone, or in combination with acid phosphate, was not satisfactory.
3. The stable manure did not increase the yield commensurate with the quantity used.

19. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY J. G. L. CROCKER, SEABOARD, NORTHAMPTON CO., N. C.

Character of Land:—Very light sandy loam, cultivated in cotton previous year. In 1887 uniformly fertilized with fertilizer, 200 pounds per acre. Proved to be not entirely of equal fertility. Nos. 1–11 were a little thinner than the remainder.

FIELD NOTES:—The directions were fully carried out by an experienced farmer. Crop planted May 1st; seed the Osier. Chopped and plowed nicely between 15th and 20th. The heavy rains threw it back some. The plots with the kainit alone and acid phosphate alone dried out so as to necessitate re-sowing about 20th May. *June*: 5th and 20th, cultivated; recovering considerably from effects of excessive rains in May. *July*: Drouth has not yet affected crop; plowed three times and kept entirely free from grass. *August*: Fair, with slight damage from drouth during July and continuing through entire month of August.

EXPERIMENTS WITH FERTILIZERS ON COTTON. J. G. L. CROCKER,
SEABOARD, NORTHAMPTON CO.

PER ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

No.	APPLICATION IN POUNDS.	Lbs. Avail. Phos. Acid.	Lbs. Nitrogen.	Lbs. Potash.	Cost.	PRODUCT.		RESULTS.		Rank.
						Pounds.	Value.	Net Gain.	Net Loss.	
1	400 Acid Phos., containing	50.16	.....	.....	\$ 3.50	420	\$ 12.60	\$.....	\$2.90	21
2	None.	.....	.....	.....	.00	400	12.00	.....	.....	18
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	37.62	13.05	11.158	4.91	1240	37.20	20.29	.....	2
4	500 C. S. Meal, “	.....	43.50	7.70	6.00	1080	32.40	14.40	.....	7
5	400 Kainit, “	.....	.....	50.56	2.80	500	15.00	.....	.20	19
6	{ 300 Acid Phos., 200 C. S. Meal, }	37.62	17.40	3.080	5.02	1120	33.60	16.40	.....	5
7	{ 300 Acid Phos., 200 Kainit, }	37.62	.....	25.23	4.02	620	18.60	4.58	.....	13
8	20 2-horse ld's. stable manure	.....	.....	.....	10.00	1460	53.80	29.30	.....	1
9	{ 250 C. S. Meal, 250 Kainit, } containing	.....	21.75	35.45	4.75	930	27.90	9.65	.....	11
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, }	25.08	17.40	28.36	5.55	1280	38.40	18.35	.....	4
11	None.	.....	.....	.....	.00	450	13.50	.....	.....	17
12	300 Acid Phos., “	37.62	.....	.....	2.62	570	17.10	.98	.....	14
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	25.08	8.70	7.86	3.30	1090	32.70	15.90	.....	6
14	400 C. S. Meal, “	.....	34.80	6.16	4.80	1060	31.80	12.50	.....	8
15	300 Kainit, “	.....	.....	37.02	2.10	490	14.70	.....	1.50	20
16	{ 200 Acid Phos., 100 C. S. Meal, }	25.08	8.70	1.54	2.95	950	28.50	11.45	.....	9
17	None.	.....	.....	.....	.00	470	14.10	.....	.....	16
18	{ 200 Acid Phos., 150 Kainit, }	25.08	.....	18.96	2.80	590	17.70	.80	.....	15
19	{ 200 C. S. Meal, 200 Kainit, }	.....	17.40	28.36	3.80	920	27.60	9.90	.....	10
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	12.54	8.70	14.18	2.77	740	22.20	5.33	.....	12
21	10 2-horse loads stable manure,	.....	.....	.....	5.00	1280	38.40	19.30	.....	3

Deductions from the results:

1. Kainit alone was not productive.
2. Stable manure in both applications showed decided improvement over unmanured plots. Using 20 2-horse loads, the yield was *three and a half times* that of the average unfertilized plot.
3. The complete fertilizer of No. 3 proved the best application next after stable manure.
4. The soil was quite uniform, and responsive to nearly all fertilizers.

15. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY P. N. BRAY, TULLS, CURRITUCK CO., N. C.

20. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY T. J. KING, LOUISBURG, FRANKLIN CO., N. C.

21. FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY A. A. PERRY, EDENTON, CHOWAN CO., N. C.

[These fertilizer experiments on cotton were satisfactorily commenced, but owing to disastrous seasons and other unfortunate circumstances were not continued, and definite results not reached.]

SUMMARY OF RESULTS OF EXPERIMENTS WITH COTTON,
SEASON OF 1888.

In the annexed table is given a summary of results of experiments with cotton, wherein the heavy type expresses the gain in money value, due to the increased yield on the fertilized plots after the cost of the application is subtracted, as compared with the value of the average yield of three unfertilized plots. The ordinary type gives the net loss in money value as compared with the average of three unfertilized plots.

The comparison can only be made on a basis of equal applications, and not on the basis of the same quantity of land. Owing to the different strength of the various soils, the distance between rows was changed so as to conform to the land. The quantity of land is therefore variable, but is expressed in each case in the appropriate columns.

The following deductions from these results can safely be made. It will be remembered that no safe permanent deductions can now be reached, for successive seasons may vary somewhat the results recorded for this year:

1. Applications of fertilizing material for this year on cotton quite unlike the result on corn, have been, with few exceptions, profitable.
2. Acid phosphate (furnishing available phosphoric acid) alone, was for the most part unprofitable.
3. Cotton seed meal (furnishing nitrogen or ammonia) alone, was profitable in a majority of cases. The loss in the remainder of the cases was comparatively slight. It would be unsafe, however, for general purposes to use this ingredient alone, without relying upon other applications.

4. Kainit (furnishing potash) alone, was unprofitable in most cases. Where it produced a greater yield, the increase was slight. While kainit might with propriety be used for specific purposes, where the land is in great need of potash, or as a rust preventive (and undoubtedly it was beneficial for this purpose,) yet for general purposes, when used alone without the addition of other ingredients, it cannot be relied on to be successful.

5. As a rule the application of stable manure has been successful, the yield due to a large amount (No. 8) being uniformly greater than that of any other application. The small amount (No. 21) gave an increased yield to a marked extent over unmanured plots. Taking into consideration the cost of the small amount, as compared with the larger, and the lack of facilities for procuring it, the percentage of profit is perhaps relatively greater with the smaller than with the larger application. For ordinary practice, then, the smaller application of ten two-horse loads will be found relatively more beneficial than double the quantity, unless it be desired to permanently improve the soil by means of the high manuring.

6. After stable manure, the best application for this season for the average soil appears to be a combination of the three ingredients: available phosphoric acid, nitrogen (or ammonia), and potash. The best proportion of these ingredients was 200 pounds acid phosphate, 100 pounds cotton seed meal, and 50 pounds kainit, to the acre of average soil. Where the land is poor, this application per acre might well be increased in the same proportion. This mixture yields on analysis 7.17 per cent. available phosphoric acid, 2.49 per cent. nitrogen, and 2.24 per cent. of potash. It (together with No. 3) more nearly corresponds with the average grade of commercial fertilizer than any other mixture used. The result of the season of 1888, therefore, does not alter our preconceived ideas of the proportion of the various ingredients in a fertilizing application for cotton.

7. The results so far recorded are for specific character of soils; and the deductions made are consequently for the average of the soils embraced in these experiments. It will be seen that the deductions may not be applicable to any class of soil. With our present knowledge, however, the special mixtures recommended will be more suitable to the average soil than any other mixture of which we have recorded results.

SUMMARY OF RESULTS OF EXPERIMENTS WITH COTTON, 1888.

[Giving net money value of yield from applications (after cost of the application is subtracted) as compared with average of three unfertilized plots: heavy type showing net gain over average of unfertilized plots; ordinary type, net loss.]

No.	APPLICATION IN POUNDS.	Pasquotank Co. Ordinary Light Loam. Per Acre.	Washington Co. Medium Light Gray Soil, with Clay Subsoil. Per .917 Acre.	Hertford Co. Medium Gray Soil, Clay or Sandy Subsoil. Per 15-16 Acre.	Johnston Co. Sandy and Clay Soil. Per 7/8 Acre.	Wayne Co. Dark Sandy Soil, with Close Subsoil. Per 2/3 Acre.	Beaufort Co. Gray Loam, with Clay Subsoil. Per 4/5 Acre.	Edgecombe Co. Average Cotton Soil, with Clay and Sand. Per Acre.	Tyrrell Co. Gray Uniform Soil. Per .951 Acre.	Halifax Co. Gray Piney Land. Per 7/8 Acre.	Northampton Co. Light Sandy Loam. Per Acre.
1	400 Acid Phos.,	\$ 12.87	9.30	2.30	3.30	4.25	9.80	1.45	2.67	4.60	2.90
2	None.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
3	{ 300 Acid Phos., 150 C. S. Meal, 70 Kainit, }	4.02	6.99	.19	.09	3 71	.69	3.14	2.24	1.01	20.29
4	500 C. S. Meal,	4.87	5.10	2.40	3.80	8.55	2.40	2.60	1.17	2.10	14.40
5	400 Kainit,	10.37	.90	.80	3.70	.65	.40	1.20	1.67	4.20	.20
6	{ 300 Acid Phos., 200 C. S. Meal, }	1.51	6.28	1.58	.58	4.42	.98	.93	3.05	1.42	16.40
7	{ 300 Acid Phos., 200 Kainit, }	8.81	.22	1.32	.22	.78	4.68	4.54	.45	1.98	4.58
8	20 2-horse l'ds. stab. man're,	6.43	2.80	1.90	5.80	1.00	10.10	13.05	7.97	4.60	29.30
9	{ 250 C. S. Meal, 250 Kainit, }	2.98	8.35	4.85	.25	2.15	7.85	9.00	2.42	3.95	9.65
10	{ 200 Acid Phos., 200 C. S. Meal, 200 Kainit, }	2.92	5.75	2.55	1.55	4.35	5.85	7.75	3.42	3.45	18.35
11	None.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	300 Acid Phos.,	3.89	7.48	13.28	1.82	4.58	1.72	1.98	.85	5.62	.9
13	{ 200 Acid Phos., 100 C. S. Meal, 50 Kainit, }	4.43	5.90	14.10	1.00	5.10	.90	7.30	2.07	2.10	15.90
14	400 C. S. Meal,	13.27	8.90	3.60	.40	2.85	1.80	.05	1.23	4.50	12.50
15	300 Kainit,	10.87	.20	1.50	1.60	3.90	3.90	8.65	.33	7.80	1.50
16	{ 200 Acid Phos., 100 C. S. Meal, }	2.42	5.35	9.95	5.95	1.85	1.25	0.00	4.22	1.45	11.45
17	None.	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
18	{ 200 Acid Phos., 150 Kainit, }	7.97	5.20	11.00	1.10	2.60	4.10	4.05	.13	5.60	.80
19	{ 200 C. S. Meal, 200 Kainit, }	5.27	4.80	4.60	.60	1.10	.10	7.10	.67	7.00	9.90
20	{ 100 Acid Phos., 100 C. S. Meal, 100 Kainit, }	5.54	1.33	10.13	3.83	.18	.37	2.43	2.60	6.23	5.33
21	10 2-horse l'ds. stab. man're,	1.47	5.10	9.17	7.80	4.10	9.10	4.25	7.57	1.70	19.30

V. METEOROLOGICAL WORK,

EMBRACING THE STATE WEATHER SERVICE*.

Under the head of the Meteorological Division is embraced the work of the N. C. State Weather Service, involving the Collection and Distribution of Meteorological Data, such as will directly aid the various agricultural industries of the state.

The scope of the work lies in the following:

1. A foreknowledge of the coming of cold waves, protecting fruit, trucking and tobacco interests.
2. A foreknowledge of the coming of frosts, to benefit the same industries.
3. The distribution to various portions of the State of telegrams, giving the probable state of the weather for the succeeding twenty-four hours.
4. The collection of various meteorological data at the location of the various co-operative field experiments, and elsewhere; and by obtaining a more perfect idea of the various climatic changes, to extend to other localities the crops found useful in portions of this and other States.
5. The collection and distribution of reports showing the effect of the weather on the crops during successive periods of their growth.

I. SIGNAL DISPLAY STATIONS.

The first three of the foregoing are accomplished by co-operation with the U. S. Signal Service through the various signal stations scattered throughout the State, which display flags to denote the probable state of the weather for the succeeding twenty-four hours, and also to disseminate the approach of frosts or cold waves. Telegrams, with these indications, are sent, without cost to the recipient, daily (except Sunday) at 8 A. M. After hoisting the particular flags corresponding with the telegram, the latter is posted on a bulletin-board for direct reference.





All that is necessary for a locality to have the benefit of these weather indications and cold wave and frost warnings is that a Western Union Telegraph office be located at this point; that the requisite signal flags be purchased; a pole and other facilities for hoisting these flags be

*Much of the work in the preparation of this report was done by Sergt. C. F. von Herrmann of the U. S. Signal Service, acting as assistant in this Division.

secured; a displayman who will receive the telegrams, post them and hoist the flags promptly, and who will take note of the verification of these signals and report the same monthly to this office on forms to be furnished. The set of four flags of standard size and bunting can be procured at about \$6.00 at this writing. If preferred they can be made more cheaply at home, for about \$3.00 per set. The former is advised as being cheaper in the end, and more uniform as compared with other localities.




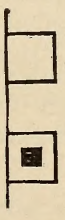
WEATHER SIGNAL FLAGS IN USE DURING 1888.

Hoisted at 8 o'clock A. M. daily (except Sunday), indicates the weather for the twenty-four hours following:

No. 1.	No. 2.	No. 3.	No. 4.
White Flag.	Blue Flag.	Black Tri- angular Flag.	White Flag— black square in centre.
			
Clear or fair weather.	Rain or snow.	Temperature signal.	Cold wave.

No. 1, white flag, 6 ft. square, clear or fair weather, no rain. No. 2, blue flag, 6 ft. square, rain or snow. No. 3, black triangular flag, 6 ft. at the base and 6 ft. in length, refers to temperature. When placed above Nos. 1 or 2, warmer weather; when placed below Nos. 1 or 2, colder weather; when not displayed, temperature stationary, or that the change in temperature will not vary five degrees of the same hour of the preceding day. No 4, cold wave flag, 6 ft. square, the approach of a sudden and decided fall of temperature. This signal is usually ordered at least twenty-four hours in advance of the cold wave. It is not displayed unless a temperature of 45 degrees or less is expected, nor is flag No. 3 displayed with it. The orange rain flag in use formerly has been discontinued.

EXAMPLES—DISPLAYED FROM POLES.

			
Fair weather. Colder.	Warmer. Rain or snow.	Warmer, fair weather, fol- lowed by rain or snow.	Fair weather. Cold wave.

LIST OF SIGNAL DISPLAY STATIONS OF THE N. C. STATE WEATHER
SERVICE IN OPERATION IN 1888.

LOCATION.	COUNTY.	DISPLAYED BY.
1. Alexander.....	Buncombe	A. E. Evans.
2. Blowing Rock.....	Watauga..	E. G. Morris.
3. Burlington.....	Alamance	C. C. Townsend.
4. Cameron.....	Moore.....	K. M. Ferguson.
5. Durham	Durham.....	H. S. Snow.
6. Davidson College.. ..	Mecklenburg.....	E. L. Siler.
7. Fayetteville.....	Cumberland	Rose & Leak.
8. Faison	Duplin	J. E. Boney.
9. Gibson Station.....	Richmond.....	W. H. Morrison.
10. Gastonia.	Gaston	J. T. Bigham.
11. Goldsboro	Wayne	T. W. Slocumb.
12. High Point	Guilford.....	Z. F. Hoffman.
13. Henderson.	Vance	T. L. Currin.
14. Hickory.....	Catawba.....	O. M. Royster.
15. Hot Springs.....	Madison.....	C. F. McGahan.
16. Jonesboro	Moore.....	C. H. Russell.
17. King's Mountain	Cleveland	A. M. Nolan.
18. Lincolnton	Lincoln.....	Jenkins Bros.
19. Lenoir	Caldwell	G. F. Harper.
20. Leaksville.....	Rockingham	J. B. Taylor.
21. Mooresboro	Cleveland	S. S. Royster.
22. Morganton	Burke	P. P. Lorbacher.
23. Magnolia	Duplin	H. J. Hope.
24. Monroe	Union	T. M. Brown.
25. Mooresville.....	Iredell.	A. Leazar.
26. Marion	McDowell.....	W. F. Craig, A. Blanton.
27. New Berne.....	Craven	W. Dunn.
28. Newton	Catawba.....	E. P. Schrum.
29. Oak Ridge	Guilford	J. A. Holt.
30. Pineville	Mecklenburg.....	W. T. Young.
31. Pittsboro	Chatham	W. R. Hunter.
32. Raleigh.....	Wake.....	H. McP. Baldwin.
33. Rockingham.....	Richmond	P. C. Cole.
34. Rocky Mount.....	Edgecombe.....	S. H. Fountain.
35. Statesville.....	Iredell	D. M. Nonn.
36. Southern Pines.....	Moore	H. W. Lloyd.
37. Shelby	Cleveland	J. G. Gardner.
38. Salisbury	Rowan	John H. Hedrick.
39. Toisnot.....	Wilson	C. F. Black.
40. Thomasville.....	Davidson	J. A. Elliott.
41. Tarboro	Edgecombe.....	E. V. Zoeller.
42. Weldon.....	Halifax.....	H. S. Cooper.
43. Wake Forest.....	Wake	C. F. Reid.
44. Warrenton	Warren	James A. Egerton, Jr.
45. Walnut Cove.....	Stokes	J. A. Burton.

PRACTICAL VALUE OF METEOROLOGICAL WORK.

Extracts from letters received in regard to the value and benefits received from the Display of Signals showing weather predictions:

D. M. Coiner, Statesville—"Would say that all persons I have talked to concerning the display of weather signals think them of very great benefit. One man told me he saved his tobacco crop by the warning of the cold wave signal. Our Chief of Police says it is a great institution, and offered as a strong argument in its favor the willingness with which people contributed toward procuring flags and poles when they are needed.

Mayor W. E. Fountain, Tarboro—"The information conveyed by the daily weather forecasts is greatly appreciated at this point. On two occasions when the weather telegrams were temporarily discontinued by the service the expense of their continuance during the interim was borne privately. To what individuals or industry it is proving most useful cannot be easily particularized, and varies with the seasons. Just now the harvesters, brickmakers and builders are perhaps receiving the greatest benefits. The forecasts have almost become to many what a daily newspaper is, and their real value would only be discerned if discontinued."

H. C. Martin, Blowing Rock—"I take pleasure in saying that the signals are carefully watched and highly appreciated by our people. Ours is an agricultural community, and being remote from railroads and daily papers the signals are of more value than they would otherwise be. I would say that the results at this place will compensate for the expense incurred by the government in furnishing them."

J. T. Gardner, Shelby—"In regard to the signals, think they have been of great benefit to this place and surrounding country. As to the Cold Wave, and in fact as to temperature, the predictions are nearly always correct, and during the cold snap last spring they were watched and much tender vegetation and young plants were saved. The farmers who are near here consult the reports when about to make hay and cut wheat. Think they are worth a great deal to the general public."

G. F. Harper, Lenoir—"I am glad to say the people watch the daily signals with much interest, and I think they fully appreciate them. During the winter most of our ice-houses were filled, as our people were all ready, having been warned by the cold wave signal. But for the signals they probably would have missed it, as the cold snap lasted but a short time last season."

J. S. Westbrook, Faison—"Would say that the daily weather telegrams and cold wave signals are closely watched, especially in winter and spring, and have been of great benefit to the community, as this is a trucking section."

W. H. Morrison, Gibson Station—"This is a farming section in the strictest sense, and the indications are noticed by a great many of our farmers, as they are the people most affected by changes in the weather. The cold wave warnings are particularly noticed by all classes. I never

hear any one say much about the indications until the wires are down, or something happens to prevent their getting here, and then the inquiries are numerous."

P. P. Lorbacher, Morganton—"The signals here are much appreciated even by the very poorest people. The 'hits' have been about eighty out of one hundred. This station (highest point on the Western Insane Asylum) can be seen, and signals read all around us for a great distance."

C. F. Reid, Wake Forest—"It is hard to estimate the value the weather signals have been to our people. They have learned to depend greatly upon them in the transaction of their daily business, and if from any cause the signals are not displayed promptly, the question is soon asked, why? We value them very highly."

H. W. Lloyd, Southern Pines—"As this place is a health resort, we think the daily telegrams and cold wave warnings highly valuable to the people of this town and to the farming interest of the surrounding country."

W. B. Devlin, Pineville—"During the harvesting season the daily weather reports were beneficial to the farmers in this section, and were eagerly looked for each morning by them."

J. R. Smith, Mount Olive—"I think the berry truckers have been benefited more than any other class of farmers."

A. D. Cole, Williamsburg, Va.—"Would say that the weather reports are a great benefit to this section, to truckers as well as those engaged in the lumber, railroad tie and oyster business."

Chas. E. Johnson & Co., Domestic and Foreign Cotton Factors, Raleigh—"We desire to state that the weather service has, in our opinion, come to be regarded as a necessity by our people, and the farming community which has access to the reports and forecasts have been greatly benefited thereby. I have watched the weather forecasts with close attention, and they have been wonderfully accurate. With regard to your Weather Crop Bulletin I cannot say too much. It is not only appreciated at home, but abroad. The system you have adopted is a most excellent one and makes the information regarding the weather and crop condition about as well defined and accurate as can be arrived at."

II. THE COLLECTION OF VARIOUS METEOROLOGICAL DATA.

As a very important item of the meteorological work of the Station the collection of various meteorological data must be carefully considered. For by this we are enabled to obtain a more perfect idea of the climatic conditions of the different localities of the State, and thereby extend to other points the crops found useful in portions of this and other States.

Advantage is taken of the co-operation of the U. S. Signal Service in securing from the observers located in the State and adjacent places in the surrounding States, careful, accurate and complete reports from those localities. Such reports embrace maximum and minimum temperature, rain-fall, barometric reading, direction and force of wind, humidity, state of weather and record of miscellaneous phenomena. In addition to these observers the weather service embraces among its numbers volun-

tary observers who are equipped with standard instruments, either procured through private subscriptions or obtained as a loan from the U. S. Signal Service. By special arrangement with the Chief Signal Officer the weather service is enabled to secure the loan of suitable instruments for recording observations to responsible parties who file an approved bond for their safe keeping, and who also agree to report monthly to the service the record of their observations. A third form of observers, whose reports are embodied herewith, is that of the cotton region observers. These reports more especially refer to the cotton growing season, but in most cases are continued from one season to another.

At this writing (1889), the list of observing stations recorded below has been largely increased: First, by the stations that have been supplied with the signal service instruments on approved bond; and second, by the co-operation of farmers conducting experiments in connection with the Experiment Station, and who at the same time take weather observations with standard instruments in connection with and furtherance of the experimental field work.

With this increase of number of observing stations we have been able to divide the State into Eastern, Central and Western Districts, and to record means for those divisions as well as for the entire State.

LIST OF METEOROLOGICAL OBSERVING STATIONS IN 1888.

LOCATION.	COUNTY.	OBSERVATIONS BY.
1. Asheville.....	Buncombe.....	Asa S. Loomis.
2. Chapel Hill	Orange.	Prof. J. W. Gore.
3. Charlotte.....	Mecklenburg	J. B. Marbury.*
4. Chattanooga.....	Hamilton county, Tenn.....	L. M. Pindell.*
5. Cheraw	Chesterfield, S. C.....	W. R. Godfrey.**
6. Davidson College.....	Mecklenburg.....	Prof. H. L. Simth.
7. Florence	Darlington, S. C.....	**
8. Goldsboro.....	Wayne.....	George C. Royal.**
9. Hatteras	Dare	Geo. H. Penrod.*
10. Hot Springs.....	Madison	C. F. McGahan, Dr. W. F. Ross.
11. Kitty Hawk.....	Currituck	William Daly.*
12. Knoxville.....	Knox county, Tenn.....	Henry Pennywitt.*
13. Lenoir.....	Caldwell	Dr. R. L. Beall.
14. Lumberton.. ..	Robeson.....	B. M. Davis.**
15. Lynchburg.....	Campbell county, Va.....	D. L. Demain.*
16. Marion.....	McDowell	A. Blanton.
17. Monroe	Union	D. C. Anderson.
18. Mount Pleasant.. ..	Cabarrus.....	H. T. J. Ludwig.
19. New Berne.....	Craven.....	W. C. G. Boyd.**
20. Norfolk	Norfolk county, Va.....	T. P. Sherry.*
21. Raleigh	Wake	H. McP. Baldwin.*
22. Salisbury.....	Rowan	John A. Hedrick.
23. Salem.....	Forsyth.....	John H. Clewell.
24. Southport.....	Brunswick.....	E. E. Perry.
25. Tarboro	Edgecombe.....	E. V. Zoeller.
26. Weldon	Halifax	T. A. Clark.
27. Wilmington	New Hanover	F. P. Chaffee.*
28. Wadesboro.....	Anson	H. H. McKeithan.**

*Observers Signal Service.

**Cotton Region Stations.

ANNUAL METEOROLOGICAL SUMMARY FOR NORTH
CAROLINA, YEAR 1888.

GEOGRAPHICAL.

The meteorological conditions tabulated in this summary relate chiefly to the climatic changes in the State of North Carolina and its adjacent territory in the States of Virginia, Tennessee and South Carolina.

North Carolina is included between the parallels $33^{\circ} 49' 55''$ and $36^{\circ} 33' 15''$ north latitude, and between the meridians $75^{\circ} 27' 12''$ and $81^{\circ} 42' 20''$ west longitude. The extreme length of the State from east to west is $503\frac{1}{4}$ miles, the extreme breadth is $187\frac{1}{2}$ miles, and its area embraces 52,286 square miles. The general topography of the land is a vast declivity, sloping from the summits of the Smoky Range Mountains (reaching an altitude of 6,688 feet in the Blue Ridge and embracing the highest land in the United States east of the Rocky Mountains) to the level of the Atlantic Ocean on the east.

The chief meteorological features during the year 1888 are presented in the following tables which have been compiled from the reports of twenty-eight observers. They comprise six tables, viz:

TABLE I.—Annual summary for the year by months;

TABLE II.—Annual summary of stations having complete or nearly complete records during the year;

TABLE III.—Showing the mean barometer, highest and lowest, for each month of the year at regular Signal Service Stations;

TABLE IV.—Showing the mean temperature, maximum and minimum, for each month of the year;

TABLE V.—Gives the monthly precipitation and number of rainy days;

TABLE VI.—Prevailing wind directions.

Miscellaneous data which could not be placed in tabular form are given below.

TABLE I.—ANNUAL METEOROLOGICAL SUMMARY FOR THE STATE OF NORTH CAROLINA, 1888.

1888.	ATMOSPHERIC PRESSURE. (Inches).			AIR TEMPERATURE. (In Degrees Fahrenheit).								RELATIVE HUMIDITY. (Percentage of).				PRECIPITATION. (Rain, Snow, Sleet, Hail). (In Inches).				WEATHER. (No. of Days).			WIND.	
	Mean.	Normal.	Departure.	Mean.	Normal.	Departure.	Highest.	Date.	Lowest.	Date.	Monthly Range.	Mean.	Normal.	Departure.	Averages for Month.	Normal.	Departure.	Clear.	Cloudy.	Rainy.	Prevailing Direction.	Average Direction for Many Years.		
January.....	30.23	30.19	+04	40.8	41.4	-0.6	75.2	8	6.0	...	69.2	76.0	77.2	-1.2	4.34	5.50	-1.16	8	11	12	11	SW.	SW.	
February.....	30.09	30.19	-10	45.4	45.0	+0.4	73.0	18, 20	9.1	28	63.9	77.1	70.4	+6.7	4.35	4.45	-0.10	8	11	10	10	NE	SW.	
March	30.11	30.04	+07	47.5	49.2	-1.7	80.5	31	14.1	14	66.4	69.8	66.2	+3.6	6.35	5.50	+0.85	11	9	11	10	SW.	SW.	
April.....	30.15	30.00	+1.5	59.6	57.5	+2.1	94.0	29	29.5	25	64.5	62.5	66.3	-3.8	1.82	4.51	-2.69	17	9	4	6	SW.	SW.	
May	29.98	30.03	-0.5	67.6	66.5	+1.1	96.0	28	33.0	2	63.0	78.8	67.9	+10.9	7.04	3.41	+3.63	9	12	13	5	SW.	SW.	
June.....	29.98	30.01	-0.3	75.3	74.6	+0.7	102.0	22	49.7	4	52.3	75.1	71.6	+3.5	3.29	4.48	-1.19	11	14	5	7	SW.	SW.	
July	30.05	30.02	+0.3	76.4	78.5	-2.1	104.0	9	52.0	2	52.0	70.3	69.7	+0.6	2.68	5.16	-2.48	12	10	9	8	NE	SW.	
August	30.07	30.04	+0.3	77.3	76.5	+0.8	102.4	8	48.5	24	53.9	79.8	74.5	+5.3	4.50	5.61	-1.11	10	12	9	11	SW.	NE.	
September....	30.07	30.08	-0.1	67.9	70.0	-2.1	97.0	1	29.0	30	68.0	85.9	74.4	+11.5	8.32	4.66	+3.66	9	8	13	14	NE.	NE.	
October	30.06	30.14	-0.8	56.6	60.8	-4.2	82.2	19	32.5	22	49.7	80.6	74.5	+6.1	4.60	3.78	+0.82	14	7	10	10	NW.	NE.	
November	30.15	30.20	-0.5	52.1	49.7	+2.4	79.8	9	25.5	28	54.3	80.9	70.6	+10.3	3.36	4.09	-0.73	11	7	12	9	NE.	NE.	
December	30.18	30.17	+0.1	41.8	41.6	+0.2	72.0	9	14.0	30	58.0	77.7	73.6	+4.1	3.49	4.85	-1.36	16	6	9	7	NW.	SW.	
Ann'l Means,	30.09	30.09	0.0	59.0	59.3	-0.3	104	.....	6.0	...	59.6	76.2	71.4	+4.8	54.14	56.00	-1.86	133	116	117	118	SW.	SW.

TABLE II.—ANNUAL SUMMARY FOR SEPARATE STATIONS, 1888.

STATIONS.	OBSERVERS.	ATMOSPHERIC PRESSURE. (1)				TEMPERATURE OF THE AIR. (2)				Relative Humidity. (Yearly Means).	Total Precipitation in Inches. (6)	Prevailing Direction of the Wind.	No. of Rainy Days. (.01 Inch or More).	No. of Cloudy Days. (6)	No. of Fair Days. (6)	No. of Clear Days. (6)	
		EXTREMES.				Yearly Means.	EXTREMES.										
		Yearly Mean Barometer.	Highest. (3)	Date.	Lowest. (4)		Date.	Min.	Date.								Max.
Chapel Hill.....	Prof. J. W. Gore.....	30.10	.63	Jan. 12	.49	Dec. 17	1.14	59.3	100	June 21	14	Feb. 28	52.1	70.1	44.23	121	
Charlotte.....	B. H. Bronson*.....	30.11	.59	Feb. 16	.49	Mch. 20	1.10	60.5(5)	98	Aug. 7	16	Feb. 28	49.2	72.4	47.11	116	
Chattanooga.....	L. M. Pindell*.....	30.11	.59	Feb. 16	.49	Mch. 20	1.10	60.5(5)	98	Aug. 7	10	Feb. 28	47.5	75.6	54.87	111	
Hatteras.....	G. H. Penrod*.....	30.11	.72	Jan. 12	.42	Dec. 17	1.30	60.7(5)	88	Aug. 9	22	Jan. 28	33.2	85.2	56.76	156	
Kitty Hawk.....	William Daly*.....	30.12	.62	Jan. 16	.56	Mch. 20	1.06	61.8	102	Aug. 8	17	Jan. 28	47.8	59.73	59.73	131	
Knoxville.....	Henry Pennywitt*.....	30.08	.79	Jan. 12	.31	Dec. 17	1.48	58.4	96	Aug. 3	9	Feb. 28	48.0	74.2	53.03	130	
Lenoir.....	Dr. R. L. Beall.....	30.08	.79	Jan. 12	.31	Dec. 17	1.48	55.8	93	Aug. 7	11	Feb. 28	50.5	67.1	48.48	113	
Lynchburg.....	J. J. Stephenson*.....	30.05	.76	Jan. 12	.22	Dec. 17	1.54	57.1	98	Aug. 8	14	Mch. 14	47.8	77.9	53.89	124	
Monroe.....	D. C. Anderson.....	30.05	.76	Jan. 12	.22	Dec. 17	1.54	57.1	98	Aug. 8	14	Mch. 14	47.8	77.9	53.89	124	
Mt. Pleasant.....	H. T. J. Ludwig.....	30.05	.76	Jan. 12	.22	Dec. 17	1.54	57.1	98	Aug. 8	14	Mch. 14	47.8	77.9	53.89	124	
Norfolk.....	T. P. Sherry*.....	30.09	.77	Jan. 12	.40	Dec. 17	1.37	59.0(5)	101	J'ne 21, July 12	15	Feb. 28	49.7	74.7	53.30	141	
Raleigh.....	H. McP. Baldwin*.....	30.09	.77	Jan. 12	.40	Dec. 17	1.37	59.0(5)	100	July 8	16	Feb. 28	39.7	53.30	53.30	141	
Salisbury.....	J. A. Hedrick.....	30.09	.77	Jan. 12	.40	Dec. 17	1.37	59.0(5)	100	July 8	16	Feb. 28	39.7	53.30	53.30	141	
Southport.....	E. E. Perry.....	30.09	.70	Jan. 12	.46	Dec. 17	1.27	62.6(5)	96	July 13, Aug 9	19	Jan. 19	37.9	60.85	103	135	
Weldon.....	T. A. Clark.....	30.09	.70	Jan. 12	.46	Dec. 17	1.27	62.6(5)	96	July 13, Aug 9	19	Jan. 19	37.9	60.85	103	135	
Wilmington.....	F. P. Chaffee*.....	30.09	.70	Jan. 12	.46	Dec. 17	1.27	62.6(5)	96	July 12	20	Jan. 19	42.6	80.4	55.07	135	

*Observers Signal Service. (1) Expressed in inches and reduced to sea-level. (2) In degrees Fahrenheit. (3) In all columns "Highest" supply 30 inches. (4) In all columns "Lowest" supply 29 inches. (5) Obtained from averages of maximum and minimum. (6) For 10 months.

TABLE III.—MEAN BAROMETER, HIGHEST AND LOWEST, 1888.
(Barometer-reading reduced to sea-level. In inches).

STATIONS.	JANUARY.			FEBRUARY.			MARCH.			APRIL.			MAY.			JUNE.			JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.			Annual Average.*
	Mean Bar.	Highest.**	Lowest.**	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	
Charlotte.....	30.21	63	81	30.10	62	65	30.11	50	58	30.15	63	75	29.99	29	77	30.00	34	78	30.07	25	85	30.08	26	84	30.08	34	62	30.07	42	51	30.16	52	77	30.17	62	49	.10
Chattanooga..	30.29	58	81	30.12	59	54	30.15	52	49	30.15	58	82	29.97	21	75	29.99	31	63	30.05	19	91	30.05	26	72	30.07	36	86	30.07	36	71	30.16	44	77	30.21	55	62	.11
Hatteras.....	30.22	72	76	30.10	60	62	30.15	50	60	30.21	64	78	30.04	32	84	30.02	36	77	30.04	28	80	30.11	27	87	30.08	29	63	30.08	45	65	30.14	56	58	30.18	64	42	.11
Lynchburg ..	30.21	79	79	30.08	64	53	30.09	46	43	30.14	62	66	29.98	29	73	29.97	30	75	30.00	26	71	30.06	29	58	30.09	....	....	30.03	37	73	30.18	68	64	30.15	63	31	.08
Knoxville.....	30.27	62	74	30.12	61	59	30.15	52	56	30.16	58	82	29.98	22	79	30.01	32	75	30.07	21	94	30.08	27	63	30.08	36	87	30.08	45	68	30.14	47	77	30.22	57	64	.12
Norfolk.....	30.18	76	70	30.03	57	48	30.02	41	34	30.08	56	57	29.92	21	67	29.90	23	66	30.05	26	70	30.03	22	61	30.06	34	68	30.04	45	48	30.14	61	50	30.14	63	22	.05
Raleigh	30.23	77	86	30.10	66	62	30.11	49	48	30.16	62	73	29.99	28	74	29.98	32	75	30.06	25	77	30.06	25	76	30.06	33	81	30.05	42	60	30.15	55	70	30.17	64	40	.09
Wilmington...	30.23	70	89	30.10	63	65	30.12	50	56	30.17	62	76	30.00	28	78	30.01	34	72	30.05	26	82	30.08	24	86	30.05	25	79	30.05	38	45	30.12	49	70	30.16	60	46	.09
Means	30.23	70	80	30.09	62	58	30.11	49	50	30.15	61	74	29.98	26	76	29.98	32	73	30.05	24	81	30.07	26	73	30.07	32	77	30.07	41	60	30.15	54	68	30.18	61	44	.09

*(In columns "Highest" supply 30 inches).

**(In columns "Lowest" supply 29 inches).

TABLE IV.—MEAN TEMPERATURES, MAXIMUM AND MINIMUM, FOR EACH MONTH OF THE YEAR 1888.
(Temperatures expressed in degrees Fahrenheit).

MONTH :	JANUARY.			FEB.			MARCH.			APRIL.			MAY.			JUNE.			JULY.			AUGUST.			SEPT.			OCTOBER.			NOV.			DEC.			YEARLY.		
	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.						
Chapel Hill.....	39.4	75	16	47.2	72	14	47.3	78	20	60.4	94	34	67.0	96	43	77.6	100	50	.....	.....	.....	.....	.....	.....	67.7	90	35	56.1	80	33	52.1	84	29	42.0	69	20	59.3	
Chattanooga.....	42.1	73	13	46.8	68	10	49.3	80	22	63.6	84	40	66.9	88	40	74.6	94	52	78.0	.....	.....	.....	.....	.....	65.8	87	38	55.2	82	37	50.6	78	27	40.8	65	20	59.1	
Charlotte.....	42.0	73	17	46.1	70	16	49.3	79	20	63.2	91	38	67.3	94	40	77.0	98	55	77.5	100	60	75.7	100	55	.....	65.7	88	38	56.3	78	37	48.9	78	30	39.8	68	20	59.1
Cheraw, S. C.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	71.8	95	43	102	53	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Davidson College.....	39.4	71	14	45.0	71	14	47.8	80	16	61.6	88	31	65.9	86	40	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Florence, S. C.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	73.3	94	45	99	56	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Goldsboro.....	44.7	69	22	46.3	66	27	48.0	69	26	57.3	75	41	66.7	77	49	83	59	.....	74.6	85	62	77.4	88	62	.....	72.6	84	50	60.8	76	48	56.8	74	38	45.3	65	28	60.3
Hatteras.....	45.0	71	14	.....	.....	.....	.....	.....	.....	.....	.....	.....	63.8	88	34	73.1	83	59	74.9	92	60	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hot Springs.....	43.6	70	17	46.1	72	22	48.5	76	22	57.5	92	39	68.6	93	46	75.8	98	58	76.5	100	59	87.3	102	58	.....	71.6	97	39	60.2	79	43	57.9	80	34	46.5	72	25	61.8
Kitty Hawk.....	40.0	70	12	45.3	67	9	46.9	76	19	61.3	85	36	65.2	87	36	73.3	95	50	75.6	93	60	74.0	96	53	.....	64.3	85	35	52.1	78	36	47.8	77	26	37.2	60	22	56.9
Knoxville.....	37.1	66	12	43.5	62	12	45.0	69	19	58.2	80	34	63.4	83	41	72.4	89	54	75.0	90	62	73.4	93	52	.....	63.6	79	29	52.5	74	34	48.6	74	27	37.2	59	15	55.8
Lenoir.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	64.0	90	41	74.1	96	48	73.9	95	55	74.2	98	53	.....	62.1	84	35	50.8	78	33	45.6	76	26	36.4	63	17	54.7
Lynchburg.....	35.6	74	14	40.5	66	11	42.7	80	16	56.3	89	31	.....	.....	.....	102	57	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lumberton.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	70.5	94	47	98	51	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Monroe.....	41.8	71	23	47.5	70	19	50.4	75	22	62.0	86	38	68.1	89	45	77.3	94	56	78.4	99	60	77.7	97	52	.....	68.1	84	37	56.7	76	37	51.5	78	29	42.7	68	20	60.4
Mt. Pleasant.....	39.6	72	16	44.2	70	14	46.8	77	17	60.2	89	35	65.4	89	40	74.2	95	52	76.6	100	57	76.2	97	48	.....	66.1	89	32	54.8	79	32	50.8	79	26	41.0	68	15	58.0
Marion.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	88	33	.....	95	51	.....	.....	95	65	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Norfolk.....	38.1	73	16	41.9	69	17	43.9	77	14	55.4	93	32	64.9	90	44	73.6	96	56	74.3	94	58	76.0	98	56	.....	68.7	88	40	55.8	76	41	52.0	80	33	40.4	66	20	57.1
New Bern.....	40.0	75	17	44.1	68	15	46.8	77	20	59.1	90	35	66.6	90	44	76.0	101	52	75.8	101	58	76.0	96	53	.....	66.6	88	39	55.2	77	33	50.9	79	30	39.9	68	18	58.0
Raleigh.....	39.8	69	20	45.3	66	16	47.8	70	28	62.7	81	42	65.2	89	48	78.6	95	62	80.0	100	66	79.0	96	62	.....	68.4	87	46	56.7	73	44	52.2	75	30	42.5	59	23	59.8
Salisbury.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	65.0	92	39	74.8	90	54	77.9	92	62	80.2	92	60	.....	74.2	88	40	62.9	77	42	57.3	74	35	46.3	62	23	63.0
Salem.....	38.0	70	14	44.0	73	12	46.0	79	17	53.0	92	31	65.0	92	39	74.8	90	54	77.9	92	62	80.2	92	60	.....	74.2	88	40	62.9	77	42	57.3	74	35	46.3	62	23	63.0
Southport.....	46.4	64	19	49.5	64	24	51.3	75	24	61.5	77	40	73.9	84	51	74.8	90	54	76.8	93	62	76.1	94	55	.....	53.7	74	35	49.0	76	28	38.6	60	17	.....	.....	.....
Statesville.....	38.9	68	15	47.0	64	12	46.6	75	18	59.6	89	35	64.0	85	40	75.8	97	52	76.8	100	57	79.5	100	54	.....	69.0	94	36	55.2	77	33	51.7	80	30	41.2	66	17	58.2
Tarboro.....	40.9	76	19	.....	.....	.....	48.4	76	22	59.9	92	34	68.1	92	44	75.4	96	50	76.6	98	52	79.0	101	50	.....	69.0	94	36	55.2	77	33	51.7	80	30	41.2	66	17	58.2
Weldon.....	37.7	72	13	43.1	73	18	45.7	76	17	56.5	91	32	68.8	91	41	75.4	96	50	76.6	98	52	79.0	101	50	.....	69.0	94	36	55.2	77	33	51.7	80	30	41.2	66	17	58.2
Wadesboro.....	68.8	91	47	75.8	96	52
Wilmington.....	46.5	75	20	49.6	72	25	51.4	76	24	61.7	88	37	69.9	86	51	75.8	94	53	75.9	96	60	76.9	95	59	.....	71.1	88	44	59.7	79	45	54.2	79	36	43.6	68	26	61.4
Averages.....	40.8	71	16	45.4	69	16	47.5	76	20	59.6	87	36	67.6	89	43	75.3	96	53	76.4	97	60	77.3	96	55	.....	67.9	87	38	56.6	77	37	52.1	78	30	41.8	65	20	59.0

TABLE V.—MONTHLY PRECIPITATION AND NUMBER OF RAINY DAYS, YEAR 1888.

(Including rain, snow, hail, sleet, etc., expressed in inches and hundredths).

STATIONS.	JAN.	FEB.	MARCH.	APRIL.	MAY.	JUNE.	JULY.	AUGUST.	SEP.	OCT.	NOV.	DEC.	TOTALS.	AVER- AGES.	No. of Mos.	
Chapel Hill.....	3.37	7*	8.73	8	9.88	12	4	.....	7.05	9	1.81	5	44.23	65	4.42	6
Cheraw, S. C.....	.....	4.01	7*	.....	3.53	9	4.53	8	4.19	.....	1.15	.....	22.29	.....	3.18	7
Chattanooga.....	6.79	16	6.86	12	4.91	16	3.31	13	5.34	15	4.66	9	54.87	140	4.57	12
Charlotte.....	4.38	14	6.22	11	5.36	7	2.36	7	6.93	13	5.87	11	47.11	141	3.93	12
Davidson College...	5.69	8	7.24	11	0.46	3	.....	.....	.....	.....	1.69	10	30.31	45	6.06	9
Florence, S. C.....	.....	.....	.....	.....	12.89	17	.....	3.08	.....	.....	.....	.....	11.93	.....	3.98	3
Goldsboro.....	.....	.....	.....	.....	7.67	14	2.10	5	5.09	.....	.....	.....	16.30	.....	4.07	4
Hatteras.....	4.85	13	5.07	10	0.77	6	.....	7	6.63	15	5.52	12	56.76	120	4.73	10
Kitty Hawk.....	5.65	10	6.75	10	1.17	12	.....	2.21	6	9.40	15	5.42	59.73	131	4.98	11
Knoxville.....	6.61	17	4.22	10	4.00	9	.....	2.77	15	6.55	13	6.11	53.03	144	4.42	12
Lenoir.....	1.90	4	4.90	6	2.30	4	.....	3.80	9	10.80	11	5.10	55.70	85	4.64	7
Lumberton.....	.....	.....	.....	.....	3.92	12	3.74	8	5.33	.....	2.64	.....	12.99	.....	4.33	3
Lynchburg.....	2.99	10	5.25	11	1.67	7	2.24	5	2.59	11	2.74	6	48.48	127	4.04	11
Marion.....	.....	.....	.....	.....	12.67	22	4.70	7	1.50	2	.....	.....	19.54	34	6.51	11
Monroe.....	3.38	13	7.56	11	0.67	3	.....	4.08	8	9.09	16	4.76	53.07	129	4.42	11
Mt. Pleasant.....	4.67	9	5.85	10	3.12	5	.....	6.18	11	9.01	13	7.09	56.52	103	4.71	9
Norfolk.....	4.42	14	4.55	11	0.97	8	.....	7.81	14	6.10	22	3.94	53.89	159	4.49	13
New Bernc.....	.....	.....	.....	.....	8.46	17	5.78	10	2.52	12	3.71	11	15.02	.....	4.49	13
Raleigh.....	3.98	16	6.88	10	1.71	5	.....	4.05	10	10.88	16	4.31	15.92	135	4.74	11
Salisbury.....	4.38	10	7.60	9	1.34	8	.....	4.26	13	12.90	11	4.71	53.30	110	4.44	9
Salem.....	5.77	6	6.33	9	1.55	4	.....	8	8.14	14	6.98	7	31.05	44	5.18	7
Southport.....	2.76	12	7.03	11	3.46	6	2.33	11	3.72	9	6.30	10	60.85	108	5.07	9
Statesville.....	5.07	.....	8.28	.....	9.54	.....	5.18	.....	.....	.....	2.88	.....	51.88	.....	5.19	10
Tarboro.....	4.18	11	5.53	11	1.77	6	.....	7	.....	.....	.....	.....	29.21	67	4.17	9
Wadesboro.....	.....	.....	.....	.....	8.09	18	5.17	7	1.62	7	.....	.....	8.65	.....	2.88	3
Weldon.....	3.83	10	7.41	10	5	.....	1.30	6	10.56	16	3.65	7	53.17	103	4.43	9
Wilmington.....	2.21	17	4.74	11	1.10	6	3.56	10	8.28	16	5.50	14	55.07	143	4.59	12
Monthly Averages..	4.34	11	6.35	10	7.04	15	3.29	8	8.32	14	4.60	10	.....	.....	4.53	10

*No. of days on which .01 inches or more fell.

TABLE VI.—PREVAILING WIND DIRECTIONS FOR THE YEAR 1888.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Chapel Hill..	W.	W.	SW.	W.	SW.	{ W., SW. }	.....	.....	W.	W.	W.	W.	W.
Chattanooga..	S.	NE.	S.	S.	{ NE., NW. }	W.	NW.	N.	NE.	{ W., NW. }	NE.	NW.	{ NE., NW. }
Charlotte.....	SW.	SW.	{ SW., NW. }	SW.	SW.	SW.	NE.	S.	.....	SW.	N.	NW.	SW.
Hatteras	N.	N.	NW.	S.	S.	SW.	NE.	S.	S.	{ N., SW., W. }	NE.	NW.	S.
Knoxville.....	W.	W.	N.	N.	SW.	SW.	E.	SW.	E.	{ SW., W. }	NE.	NW.	SW.
Lenoir.	NW.	NE.	NW.	SW.	SW.	W.	{ W., SW. }	SW.	E.	NW.	NE.	NW.	{ NW., SW. }
Lynchburg...	{ SW., NW. }	{ NE., NW. }	NW.	NW.	NE.	NE.	{ SE., NE. }	S.	.....	S.	NW.	NW.	NW.
Monroe	NW.	SW.	NW.	SW.	SW.	SW.	SE.	SW.	NE.	{ SW., NW. }	NE.	NW.	SW.
Mt Pleasant..	SW.	NE.	NE.	SW.	SW.	SW.	SE.	SW.	NE.	NW.	N.	NW.	SW.
Norfolk.....	E.	N.	SE.	{ N., NE. }	S.	NE.	NE.	SE.	NE.	SE.	NE.	NW.	NE.
Raleigh.....	NW.	SW.	NW.	{ NE., NW. }	SW.	SW.	N.	SW.	NW.	{ SW., NW. }	NW.	NW.	NW.
Salem.....	SW.	N.	N.	N.	N.	.....	.....	.....	.....	.....	.....	NE.	.....
Southport.....	SW.	SW.	SW.	SW.	SW.	SW.	SW.	SW.	SW.	SW.	NE.	W.	SW.
Tarboro	NW.	.....	NW.	NE.	S.	SE.	S.	S.	.....	.....	N.	NW.	.....
Weldon.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilmington..	NW.	NE.	SW.	SW.	SW.	SW.	E.	SW.	NE.	S.	NE.	N.	SW.
Averages...	NW.	NE.	NW.	SW.	SW.	SW.	NE.	SW.	NE.	{ SW., NW. }	NE.	NW.	SW.

EXPLANATION OF THE TABLES.—*Pressure*.—The monthly mean pressure has been obtained from January 1st to June 30th, 1888, by dividing the sum of the average pressure at 7 A. M., 3 P. M. and 10 P. M. by three; from July 1st to December 31st it was obtained by dividing the sum of the average pressure at 8 A. M. and 8 P. M. by two. The annual mean pressure is obtained by dividing the sum of the mean pressures for each month by twelve.

The normal monthly pressure is obtained by taking the sum of the mean monthly pressures for many years, and dividing by the number of years taken. The normals for this State for 1888 have been obtained from the records of seven Signal Service stations from January, 1880, to December, 1884, inclusive. Normals are, of course, more accurate if calculated from data covering a long period of time, say twenty-five or thirty years. For the year 1889, it is proposed to use the monthly normal pressures and temperatures prepared by assistant Professor H. A. Hazen (Report of the Chief Signal Officer, 1888. Appendix No. 19, pages 287 to 294), in which the pressure normals are for fifteen years, those for temperature for eight years.

Temperature.—Until June 30th, 1888, observations of temperature were taken at regular Signal Service stations daily at 7 A. M., 3 P. M. and 10 P. M., and the monthly mean temperatures from those stations are obtained by dividing the 7 A. M., 3 P. M. and 10 P. M. averages by three. At many volunteer stations temperature observations are taken at 7 A. M., 2 P. M. and 9 P. M., and a very accurate monthly mean is obtained by dividing the sum of the 7 A. M., 2 P. M. and twice the 9 P. M. observations by four. At a number of stations which report only maximum and minimum temperatures a tolerably accurate monthly mean has been obtained by dividing the sum of the average maximum and minimum temperatures by two. This last method is now used by the Signal Service at all its regular stations.

Precipitation.—This includes rain, melted snow, sleet or hail. An inch of unmelted snow is equivalent to one-tenth of an inch of rain-fall.

Weather.—The state of the weather at any time is determined by the amount of clouds observed. The weather is *clear* when the sky is three-tenths or less than three-tenths covered with clouds; *fair* when the sky is from four to seven-tenths (both inclusive) covered; *cloudy* when the sky is more than seven-tenths covered. Thus a day would be considered *clear* if the average amount of clouds observed during the day did not exceed three-tenths, *fair* if it did not exceed seven-tenths, *cloudy* if the average amount of clouds observed was eight-tenths or more. The sum of the clear, fair and cloudy days must make up the total number of days of the month or of the year. A *rainy* day is one on which .01 inch or more of precipitation has fallen. It has nothing to do with the amount of clouds observed.

GENERAL REMARKS.

The year 1888 was about an average one in most respects. The mean pressure for the year was 30.09 inches, the same as the normal pressure. Also the annual mean temperature only differed by -0.3 degrees from the normal. The mean temperature for 1887 was 59.1 degrees, that for 1888 was 59.0. The average precipitation for the year was 54.14 inches. For the preceding year it was considerably less, being only 49.37 inches. The prevailing wind direction was south-west. The last killing frost of the winter of '87 and '88 occurred on May 15th, 1888. The last snow occurred on March 22d, 1888. The first killing frost of the winter of '88 and '89 occurred on September 30th, 1888. The average date for the first killing frost in the State is October 10th. A slight earthquake shock was felt throughout the State about 10 A. M. January 12th, 1888.

Pressure.—The highest barometer observed during the year was 30.79 inches at Lynchburg, Va., on January 12th. The lowest barometer occurring was 29.22 inches at Norfolk, Va., on December 17th. The absolute range for the State was therefore a little over an inch and a half. It may be remarked that the notable storm of November, 1888, (23d to 28th; see Monthly Weather Review, Nov., 1888, page 272), which was a violent hurricane passing along some distance east of the Atlantic coast, did not cause a particularly low barometer in any portion of this State.

Temperature.—The mean temperature for the year, 59 degrees, is about the average. The highest yearly mean temperature, 63 degrees, occurred at Southport, N. C. The lowest yearly mean temperature was 54.7 degrees at Lynchburg, Va. The highest mean monthly temperature was 87.3 degrees at Kitty Hawk, N. C., in August. The lowest mean monthly temperature was 35.6 degrees at Lynchburg, Va., in January. The highest actual temperature was 104 degrees at Cheraw, S. C., in July. The highest within the State was 102 degrees, on the 8th of August, 1888, at Kitty Hawk, N. C. The lowest temperature was 6.0 degrees in January, at Asheville, N. C. Range of temperature for the State, 98 degrees. The highest temperature ever before recorded was 107.1 degrees at Kitty Hawk, July 18th, 1887. The lowest ever before recorded was 18 degrees below zero, at Knoxville, Tenn., in 1884.

Relative Humidity.—Annual mean, 76.2 per cent., which was 4.8 per cent. above the normal. The highest mean relative humidity occurred in September coincident with the heaviest rain-fall for the State. At Monroe, N. C., the mean humidity for the year was 88.1 per cent., which is the highest recorded. The lowest was 67.1 per cent. at Lynchburg, Va.

Precipitation.—Some interesting facts are brought out by Table V, giving the monthly precipitation at each station. Considering the monthly averages (lowest line of the table) it will be seen that the least rain-fall occurred in April, during which month an average of only 1.82 inches fell. During the following month, however, the rain-fall was

much greater, the average for May being 7.04 inches. The heaviest rain-fall occurred in September, average 8.32 inches. The largest yearly total (only stations having complete records considered) was 60.85 inches at Southport, N. C. Kitty Hawk, N. C., follows with 59.73 inches. Rain-fall may be considered *very* excessive if it exceeds ten inches during any month. In 1888 this occurred at three stations during May, and at five stations in September, viz.:

May—Davidson College, Mecklenburg county, N. C.....	12.89 inches.
“ Lenoir, Caldwell county	10.00 “
“ Marion, McDowell county	12.67 “
September—Lenoir, Caldwell county	10.80 “
“ Lynchburg, Va	10.58 “
“ Raleigh, Wake county	10.88 “
“ Salisbury, Rowan county	12.90 “
“ Weldon, Halifax county	10.56 “

The greatest monthly rain-fall was 12.90 inches at Salisbury, N. C., in September. The least was 0.46 inches at Davidson College in April. The monthly mean for the year, calculated from data covering the whole State, was 4.53 inches. The largest number of rainy days occurred in May and September, the least in April.

Wind.—Prevailing direction for the year, South-west. The highest velocities reported each month were as follows:

January, 1888—Highest velocity, 43 miles North, at Hatteras, N. C., on the 19th.

February—Highest velocity, 50 miles from the West, at Hatteras on the 27th.

March—Highest velocity, 60 miles from the North-west, at Hatteras on the 12th.

April—Highest velocity, 46 miles North, at Hatteras on the 13th.

May—Highest velocity, 35 miles from the North, at Hatteras on the 2d.

June—Highest velocity, 36 miles South-west, at Norfolk, Va., on the 23d.

July—Highest velocity, 36 miles from the North-west, at Norfolk, Va., on the 9th.

August—Highest velocity, 38 miles from the South, at Norfolk, Va., on the 21st.

September—Highest velocity, 52 miles from the North-west, at Hatteras on the 25th.

October—Highest velocity, 40 miles from the North and north-west, at Hatteras on the 20th and 21st.

November—Highest velocity, 66 miles from the North, at Hatteras on the 25th.

December—Highest velocity, 50 miles from the North-west, at Hatteras on the 11th.

MISCELLANEOUS PHENOMENA.

January, 1888.

Thunder-storms.—No thunder-storms occurred during the month.

Hail.—Hail occurred at Salisbury, N. C., on the 12th; at Weldon on the 17th; at Lenoir on the 12th.

Sleet.—Sleet occurred at Monroe, N. C., on the 12th and 21st; at Mt. Pleasant on the 17th and 18th; at Salisbury on the 11th; at Raleigh on the 16th and 17th; at Salem on the 13th, 14th, 16th and 17th; at Lenoir on the 13th and 16th.

Frosts.—Frost occurred on the following dates: 2d, 3d, 4th, 5th, 10th to 16th, inclusive; 18th, 19th, 21st, 22d, 24th to 29th inclusive.

Solar Halos.—Hatteras, N. C., on the 29th; Chattanooga, Tenn., on the 11th.

Lunar Halos.—Charlotte, N. C., on the 31st.

February.

Thunder-storms.—Thunder-storms occurred at Weldon and Raleigh on 11th; at Wilmington on the 23d.

Hail.—Hail fell at Weldon on the 11th.

Sleet.—Weldon on the 12th; at Salem on the 11th; at Salisbury and Mt. Pleasant on the 11th.

Frosts.—Frosts occurred at Weldon on the 2d and 3d; at Salem on the 3d, 6th, 9th, 14th and 27th; at Kitty Hawk on the 1st, 2d, 3d, 11th, 12th, 14th, 16th, 17th, 28th and 29th; at Mt. Pleasant on the 1st, 3d, 9th, 14th and 17th; at Salisbury on the 3d, 9th, 14th, 27th and 28th; at Monroe on the 9th, 14th, 29th; at Charlotte on the 9th, 14th, 16th, 17th, 26th; at Raleigh on the 1st, 3d, 9th, 13th, 14th, 16th, 19th and 28th; at Wilmington on the 2d and 14th; at Lynchburg, Va., on the 1st, 3d, 6th, 9th, 14th, 16th, 19th and 22d; at Norfolk, Va., on the 2d, 3d, 16th, 17th, 28th and 29th; at Knoxville, Tenn., on the 13th, 16th, 26th, 27th and 28th; at Chattanooga, Tenn., on the 9th, 13th, 14th, 26th, 27th, 28th and 29th.

Solar Halos.—Observed at Charlotte on the 7th.

Lunar Halos.—Lynchburg on the 22d; at Raleigh on the 22d and 23d; at Mt. Pleasant on the 16th, 22d and 23d; at Weldon on the 22d and 23d.

March.

Thunder-storms.—Thunder-storms occurred at Knoxville, Tenn., on the 20th and 21st; at Mt. Pleasant, N. C., on the 21st; at Salisbury on the 17th, 21st and 28th; at Lenoir on the 17th and 21st; at Davidson College and Monroe on the 17th and 21st; at Charlotte on the 17th and 28th.

Frosts.—Frosts occurred at Charlotte on the 7th, 8th, 12th, 13th, 18th, 19th and 23d; at Monroe on the 9th, 10th, 18th and 19th; at Mt. Pleasant on the 9th, 10th, 16th, 18th, 19th and 30th; at Salisbury on the 6th, 8th, 9th, 16th, 18th, 30th; at Weldon on the 1st, 7th, 8th, 9th, 10th, 16th and 18th; at Raleigh on the 7th, 8th, 12th, 13th, 18th, 19th, 22d

and 23d; at Kitty Hawk on the 6th, 10th, 15th, 16th and 17th; at Hatteras on the 7th, 10th and 19th; at Wilmington on the 9th, 10th and 30th; at Salem on the 6th, 12th and 13th; at Norfolk, Va., on the 6th, 7th, 8th, 10th, 14th, 15th, 16th and 19th; at Lynchburg, Va., on the 7th, 10th, 16th, 18th, 19th and 30th; at Knoxville, Tenn., on the 8th, 12th, 14th, 15th, 16th and 23d; at Chattanooga, Tenn., on the 6th, 7th, 8th, 12th, 13th, 14th, 15th, 16th, 22d and 23d.

Solar Halos.—Hatteras and Weldon on the 10th.

Lunar Halos.—Monroe and Mt. Pleasant on the 18th.

April.

Thunder-storms.—Chapel Hill on the 3d; Charlotte on the 2d, 3d, 18th and 19th; at Davidson College on the 18th and 19th; at Lenoir on the 2d, 6th, 18th and 19th; at Monroe on the 2d and 18th; at Mt. Pleasant on the 2d, 18th and 19th; at Marion, N. C., on the 18th and 19th; at Raleigh on the 3d and 18th; at Salisbury on the 3d and 20th; at Tarboro on the 2d, 18th and 19th; at Wilmington on the 2d, 19th and 20th; at Knoxville on the 2d, 6th, 10th and 18th.

Frost.—Frosts occurred at Chapel Hill on the 25th, 26th; at Charlotte on the 21st, 24th, 25th, 26th; at Lenoir on the 13th, 14th, 21st, 24th, 25th, 26th; at Monroe on the 21st, 24th, 25th, 26th, 27th; at Mt. Pleasant on the 21st, 24th, 25th, 26th; at Marion on the 13th, 14th, 25th and 26th; at Raleigh on the 21st, 24th, 25th, 26th; at Salisbury on the 24th, 25th, 26th; at Tarboro on the 9th, 14th, 21st, 22d, 23d, 24th, 25th and 26th; at Weldon on the 9th, 17th, 21st, 24th, 25th, 26th, 27th; at Norfolk, Va., on the 9th, 25th, 26th; at Lynchburg, Va., on the 21st, 24th, 25th and 26th.

Solar Halos.—At Weldon on the 19th.

Lunar Halos.—Charlotte on the 22d.

May.

Thunder-storms.—Raleigh on the 6th, 19th, 26th and 30th; at Weldon on the 12th, 14th, 19th, 23d, 25th, 29th and 31st; at Tarboro on the 1st, 5th, 7th, 12th, 25th; at Hatteras on the 1st, 23d, 24th and 31st; at Charlotte on the 4th, 5th, 6th, 9th, 11th, 12th, 16th, 28th, 29th, 30th and 31st; at Lynchburg, Va., on the 12th, 25th and 29th.

Frosts occurred at Chattanooga, Tenn.; Lynchburg, Va.; Knoxville, Tenn.; Charlotte, Lenoir, Monroe and Salem on the 15th; at Marion on the 2d.

Solar Halos.—None were observed.

Lunar Halos.—Charlotte on the 24th; Hatteras on the 19th; at Lynchburg, Va., on the 20th.

June.

Thunder-storms.—Thunder-storms occurred at Weldon on the 2d, 21st and 27th; at Tarboro on the 2d, 7th, 10th, 15th, 18th, 27th and 28th; at Lenoir on the 7th, 8th, 9th, 21st, 22d, 24th and 28th; at Monroe on

the 2d, 13th; at Salisbury on the 1st, 8th, 16th, 21st and 24th; at Marion on the 9th; at Wilmington on the 17th, 24th and 29th; at Mt. Pleasant on the 1st, 2d, 3d, 7th, 18th, 21st and 22d; at Lynchburg, Va., on the 10th, 16th, 22d and 24th; at Knoxville, Tenn., on the 10th, 14th, 16th, 20th, 23d and 28th; at Hatteras on the 1st, 3d, 11th, 24th and 28th; at Charlotte on the 1st, 2d, 7th, 15th and 19th; at Raleigh on the 1st, 2d and 19th.

Solar Halos.—Mt. Pleasant on the 16th; Charlotte on the 27th.

Lunar Halos.—Knoxville, Tenn., on the 15th; Lynchburg, Va., on the 23d.

July.

Thunder-storms. At Knoxville, Tenn., on the 4th, 5th, 7th, 8th, 27th and 29th; at Charlotte on the 4th, 10th, 26th, 27th, 28th, 30th and 31st; at Monroe on the 26th, 27th; at Lenoir on the 7th and 20th; at Lynchburg, Va., on the 5th, 9th and 20th; at Hatteras on the 8th; at Wilmington on the 8th, 13th, 25th, 27th, 28th and 29th.

August.

Thunder-storms. At Lenoir on the 3d, 8th, 9th; at Tarboro on the 5th, 8th, 9th, 13th, 19th and 20th; at Monroe on the 2d, 8th, 9th, 31st; at Mt. Pleasant on the 2d, 3d, 4th, 5th, 8th, 9th and 19th; at Salisbury on the 3d, 4th, 8th, 9th; at Wilmington on the 2d, 9th, 10th, 11th, 13th and 19th; at Lynchburg, Va., on the 8th, 9th, 17th; at Hatteras on the 2d, 6th, 10th, 11th and 13th; at Raleigh on the 7th, 8th and 19th.

Hail.—Hail fell at Mt. Pleasant on the 9th, and at Salisbury on the 4th.

Lunar Halo observed at Lynchburg, Va., on the 4th.

September.

Thunder-storms.—Mt. Pleasant on the 21st; at Wilmington on the 1st, 4th, 6th and 7th; at Hatteras on the 3d.

Frosts.—Frost occurred at Lenoir, Chattanooga, Tenn., and Knoxville, Tenn., on the 29th and 30th; at Weldon, Salisbury, Mt. Pleasant, Chapel Hill, Monroe and Raleigh on the 30th.

Lunar Halos.—Mt. Pleasant and Raleigh on the 13th; Weldon on the 19th.

October.

Thunder-storms.—Thunder-storms occurred at Hatteras and Wilmington on the 2d; at Monroe, Mt. Pleasant and Salisbury on the 6th.

Frosts occurred at Weldon on the 4th, 10th, 15th, 21st, 22d and 29th; at Wilmington on the 15th; at Salisbury on the 1st, 2d and 22d; at Mt. Pleasant on the 1st, 4th, 21st, 22d, 29th, 30th, 31st; at Monroe on the 1st, 3d, 4th, 17th, 29th; at Charlotte on the 1st, 4th, 22d, 29th; at Chattanooga, Tenn., on the 3d, 4th, 13th, 14th, 21st and 29th.

Hail fell at Mt. Pleasant on the 6th.

Solar Halos.—At Weldon on the 10th.

November.

Thunder-storms occurred at Wilmington on the 14th.

Frosts.—Salem on the 6th, 7th, 13th, 14th, 18th, 27th and 29th; at Wilmington on the 29th and 30th; at Norfolk, Va., on the 28th; at Kitty Hawk on the 12th, 13th, 29th and 30th; Knoxville, Tenn., killing frost on 12th, 24th, 26th, 27th 28th and 29th; Charlotte on the 11th, 12th, 13th, 22d, 23d, 25th, 26th, 27th, 28th, 29th and 30th; at Chattanooga, Tenn., on the 12th, 23d, 25th, 26th, 27th; at Monroe on the 11th, 12th, 13th, 25th to 30th; at Weldon on the 12th, 13th, 23d, 26th; Salisbury 12th, 13th, 25th to 30th; at Mt. Pleasant 11th, 12th, 13th, 25th to 30th (incl.); at Raleigh 12th, 13th, 14th, 18th, 19th, 21st, 23d, 28th, 29th, 30th.

Hail fell at Weldon on the 22d.

Solar Halos.—Hatteras and Mt. Pleasant on the 13th.

Lunar Halos at Hatteras on the 17th; at Mt. Pleasant on the 12th, 13th and 17th.

December.

Thunder-storms.—None reported.

Frosts occurred on the following dates: 1st to 9th (incl.); 12 to 15th; 19th to 25th; 28th to 31st.

Sleet fell at Salisbury on the 13th.

Solar Halos.—Hatteras on the 16th.

Lunar Halos.—Hatteras on the 15th; at Weldon on the 7th, 12th and 15th; at Raleigh on the 7th.

3. WEEKLY WEATHER CROP BULLETIN.

The Weekly Weather Crop Bulletin furnishes an additional value to the meteorological work of the Station. For through this means the Station has been able to collect and distribute reports from points throughout the State, showing the effect of the weather on the crops during successive periods of their growth.

The crop correspondents mail their reports on Friday for the previous week. By Saturday about noon, all of these having come in, are at once embodied in a weekly weather crop bulletin, which is immediately printed and mailed on the late Saturday afternoon trains. Copies are sent each week to all of the newspapers in the State, to all crop correspondents, and to numerous Boards of Trade in North Carolina and adjoining States. In addition many of these reports go each week to firms and business houses in this country and abroad.

In order to facilitate comparison the State has been divided into three districts—the Eastern, Central and Western. The Eastern Dis-

trict embraces the following counties: Currituck, Camden, Pasquotank, Perquimans, Chowan, Gates, Hertford, Bertie, Northampton, Halifax, Nash, Edgecombe, Martin, Washington, Tyrrell, Dare, Hyde, Beaufort, Pitt, Wilson, Wayne, Green, Lenoir, Craven, Pamlico, Carteret, Jones, Onslow, Duplin, Sampson, Robeson, Bladen, Pender, New Hanover, Brunswick and Columbus—36.

The Central District embraces the following counties: Warren, Franklin, Wake, Johnston, Harnett, Cumberland, Richmond, Moore, Chatham, Durham, Granville, Vance, Person, Orange, Caswell, Alamance, Rockingham, Guilford, Randolph, Montgomery, Anson, Union, Stanly, Davidson, Forsyth and Stokes—26.

The Western District embraces the following counties: Surry, Yadkin, Davie, Rowan, Cabarrus, Mecklenburg, Gaston, Lincoln, Catawba, Iredell, Alexander, Wilkes, Alleghany, Ashe, Watauga, Caldwell, Burke, Cleveland, Rutherford, McDowell, Mitchell, Yancey, Madison, Buncombe, Henderson, Polk, Transylvania, Haywood, Jackson, Swain, Graham, Macon, Clay and Cherokee—34. Total counties in State—96.

The State was divided in this way for geographical, topographical and agricultural reasons. The Eastern District includes, geographically, about one-third of the State. Omitting sounds and water courses, the land area is so nearly one-third of the State as can be divided by whole counties. This district also represents that portion of the State reached by navigable streams which empty into the Atlantic ocean. Topographically this district is level and unbroken, with but few hills, except on the western border, where the average elevation is about 250 feet. Agriculturally the cultivation of cotton and corn predominates. In addition to these staples tobacco is cultivated in some of the north-western counties of the district. Trucking is extensively followed; and in the south-eastern counties rice is grown in addition to the other staple crops.

The Central District embraces the central belt of counties, and in extent very nearly equals the Eastern District. The elevation extends from an average of 250 feet on the east to 800 feet on the west. In the northern tier of counties tobacco is the predominating staple crop; in the centre and southern portion cotton, corn and wheat. The Central District, topographically, is intermediate between the low, level lands of the east and the hilly and mountainous lands of the west.

The Western District embraces the Piedmont and mountainous sections, the latter reaching the greatest elevations (average of 5,000 feet) in the central portion of the district. From this point, east and west, the descent is decided. Towards the east, at the dividing line between this and the Central District, the elevation is an average of 800 feet; to the west, at the Tennessee line, the average elevation is about 2,000 feet. In the north of the district tobacco and wheat predominate; in the south, wheat, corn and cotton, and in the west, wheat, tobacco, corn and the grasses.

For convenience of reference a map of the State, showing the districts, is inserted in this report, and can be seen on page 66.

LIST OF WEATHER CROP CORRESPONDENTS FOR 1888.

1. EASTERN DISTRICT.

NAME.	LOCATION.	COUNTY.
1. David Pierce.....	Beaufort.....	Carteret.
2. G. D. Pool*	Elizabeth City.....	Pasquotank.
3. A. A. Perry	Edenton.....	Chowan.
4. J. S. Westbrook*	Faison	Duplin.
5. J. W. Bryan.....	Goldsboro.....	Wayne.
6. David Cox*.....	Hertford.....	Perquimans.
7. Sterling M. Gary.....	Halifax.....	Halifax.
8. John F. Newborn*	Kinston.....	Lenoir.
9. S. Johnson	Littleton	Halifax.
10. John H. McNeill*.....	Lumberton.....	Robeson.
11. W. H. Oliver.....	New Berne.....	Craven.
12. T. H. Battle.....	Rocky Mount.....	Edgecombe.
13. W. B. Hocut.....	Rocky Point.....	Pender.
14. W. H. Shields*.....	Scotland Neck.....	Halifax.
15. E. V. Zoeller	Tarboro	Edgecombe.
16. A. F. Black	Toisnot	Wilson.
17. Matt. J. Pearsall	Warsaw	Duplin.
18. T. A. Clark*.....	Weldon.....	Halifax.
19. Henry E. Biggs.....	Williamston.....	Martin.

*Supplied with rain-gauges.

2. CENTRAL DISTRICT.

NAME.	LOCATION.	COUNTY.
1. E. J. Parish.....	Durham.....	Durham.
2. L. C. Rankin.....	Fayetteville.....	Cumberland.
3. W. H. Morrison.....	Gibson Station	Richmond.
4. D. W. C. Benbow.....	Greensboro	Guilford.
5. C. B. Wright.....	Haw River	Alamance.
6. H. P. Jones*.....	Hillsboro.....	Orange.
7. Theo. B. Wilder.....	Louisburg.....	Franklin.
8. D. C. Anderson*	Monroe.....	Union.
9. John Webb, W. F. Lyon.....	Oxford	Granville.
10. A. G. Headen.....	Pittsboro.....	Chatham.
11. B. S. Skinner.....	Raleigh.....	Wake.
12. W. I. Everett.....	Rockingham	Richmond.
13. R. D. Luncford.....	Smithfield	Johnston.
14. H. C. Case.....	Salem.....	Forsyth.
15. R. P. McAnally*.....	Walnut Cove.....	Stokes.
16. P. H. Allen.....	Warrenton	Warren.
17. C. F. Reid.....	Wake Forest	Wake.

*Supplied with rain-gauges.

3. WESTERN DISTRICT.

NAME.	LOCATION.	COUNTY.
1. Locke Craig.....	Asheville	Buncombe.
2. John H. Tinley.....	Bat Cave.	Henderson.
3. E. Everett.....	Charleston	Swain.
4. Jas. A. Barry.....	Charlotte.....	Mecklenburg.
5. H. P. Helper*.....	Davidson College.....	Mecklenburg.
6. J. T. Bigham.....	Gastonia	Gaston.
7. J. W. Monser.....	Hickory	Catawba.
8. C. H. Russell.....	Jonesboro.....	Moore.
9. Robt. L. Beall*.....	Lenoir.....	Caldwell

NAME.	LOCATION.	COUNTY.
10. A. Nixon.....	Lincolnton	Lincoln.
11. W. F. Craig*.....	Marion	McDowell.
12. T. B. Ashby.....	Mt. Airy	Surry.
13. John Tull.....	Morganton	Burke.
14. H. T. J. Ludwig*.....	Mt. Pleasant	Cabarrus.
15. D. C. Anderson*.....	Monroe	Union.
16. J. A. McDonald*.....	Shelby	Cleveland.
17. W. M. Sanders.....	Smithfield	Johnston.
18. John A. Hedrick*.....	Salisbury.....	Rowan.

*Supplied with rain-gauges.

A specimen of the matter contained in the crop bulletins is given below, and will fully show their scope:

18th WEEKLY WEATHER CROP BULLETIN

OF THE

NORTH CAROLINA WEATHER SERVICE,

CO-OPERATING WITH THE U. S. SIGNAL SERVICE,

FOR THE WEEK ENDING SATURDAY, SEPTEMBER 29TH, 1888.

CENTRAL OFFICE, AGRICULTURAL BUILDING, RALEIGH, N. C.

RAIN-FALL.

There was a slight excess of rain-fall in the *Eastern District* during the past week. In the *Central* and *Western Districts* the rain-fall was apparently below the average, and all crops are somewhat improved. Tobacco appears to have suffered as much as any crop from the wet weather which prevailed during the first part of the month. The quality of tobacco will probably not be as good as usual. The latter part of the week has generally been very favorable to cotton picking and the saving of the crops.

TEMPERATURE AND SUNSHINE.

The temperature throughout the State has probably been slightly below the normal. Light frost is reported from a number of places in Wake county this (Saturday) morning, and probably occurred in many places in the Central and Western Districts. The sunshine has been below the average.

REMARKS OF SPECIAL CORRESPONDENTS.

EASTERN DISTRICT. *Elizabeth City, Pasquotank county*—"On yesterday, the 27th, we had a heavy rain, damaging all crops to a considerable extent, except rice. Cotton is very much injured; also peas." *Faison, Duplin county*—"Heavy rains again the first of the week, but we have nice weather now and cotton is being gathered rapidly, but of inferior quality." *Goldsboro, Wayne county*—"Cotton is seriously damaged from the late wet weather, but not so much as it at first appeared to be." *Hertford, Perquimans county*—"Cotton has taken rust, more than for the past five years." *Lumberton, Robeson county*—"Cotton has been injured by the wet weather, some say one-third off." *New Berne, Craven county*—"Four days of rain; cotton badly damaged." *Rocky Point, Pender county*—"The clear weather of the past seven days has caused cotton to open rapidly. The farmers find it not so much dam-

aged by the rains as they thought. All other crops good." *Toisnot, Wilson county*—"Cotton is opening rapidly, and the prospect is better for a fair yield. Cotton of first picking very blue." *Warsaw, Duplin county*—"Good weather for picking cotton and setting out strawberries."

CENTRAL DISTRICT. *Durham, Durham county*—"No change in crop prospects since last report." *Fayetteville, Cumberland county*—"The weather has been favorable for picking cotton, which has been greatly damaged by rain." *Gibson's Station, Richmond county*—"The weather for the past four days has been very favorable for cotton picking." *Haw River, Alamance county*—"Nothing new to report about crops, save that tobacco is hard to cure." *Hillsboro, Orange county*—"Cool nights and heavy dews, very beneficial to the tobacco crop." *Louisburg, Franklin county*—"Have had fair weather, except one day of rain." *Oxford, Granville county*—"The curings of tobacco in the northern and western portions of the county are the worst since 1881." *Pittsboro, Chatham county*—"Very little rain since last report, which has been favorable to cotton opening and picking." *Raleigh, Wake county*—"Weather favorable for maturing and gathering all crops." *Salem, Forsyth county*—"No rain-fall, which has been favorable for all crops." *Smithfield, Johnston county*—"The weather is good now, and grade of cotton improving." *Warrenton, Warren county*—"Cotton opening slowly. Very little picking, owing to the excess of rain. Rottening in the boll and badly damaged by rust. Tobacco has turned green and only a very small proportion can be cured bright, not more than 25 per cent."

WESTERN DISTRICT. *Bat Cave, Henderson county*—"It has been cloudy and damp. Crops will be short." *Charleston, Swain county*—"Sunshine has been a great benefit to tobacco, sweet potatoes, and all vegetables." *Davidson College, Mecklenburg county*—"No rain the past week. Weather is delightful, well suited to cotton and all crops." *Gastonia, Gaston county*—"On the night of the 21st instant we had thunder, lightning, hail and a storm of wind and rain. The fair weather since has been very favorable." *Hickory, Catawba county*—"Cotton is opening very well, though late, on account of the very rainy weather. Tobacco is not very good." *Morganton, Burke county*—"The very heavy rains of the last week have damaged the corn very materially." *Mt. Airy, Surry county*—"Have had no rain of notice since last report. Farmers report that crops will generally be very poor." *Mt. Pleasant, Cabarrus county*—"The heavy rain-fall on the night of the 21st, 1.60 inches, created freshets in some of the creeks and damaged corn in the low lands." *Salisbury, Rowan county*—"Have examined the corn along the Yadkin River, and find the damage much less than was at first supposed. The weather this week has been favorable for it to dry out. The loss will not exceed ten per cent." *Shelby, Cleveland county*—"Cotton is opening very fast." *Walnut Cove, Stokes county*—"The cool, heavy dews of the past week were very favorable to tobacco."

RESOLUTIONS OF INSTRUCTION TO OUR SENATORS AND REPRESENTATIVES IN CONGRESS IN RELATION TO THE SIGNAL CORPS SERVICE.

The following resolution passed by the Legislature of North Carolina at its recent session, will tend to show the appreciation, by the people generally, of the value of the Signal Service and of the State Weather Service. The efficiency of the latter, especially, would be placed on a much better footing if the bill referred to were to pass:

WHEREAS, North Carolina is greatly concerned in the efficiency of the United States Signal Corps; and whereas, the weather and crop reports emanating from the Signal Service of the Government are of great benefit to our people; now therefore, be it

Resolved by the Senate, the House of Representatives concurring: That our representatives in Congress be requested and our Senators instructed, to take all necessary steps to aid in the passage of the bill now pending in Congress, known as the Senate bill number two thousand two hundred and three, and entitled "An Act to Increase the Efficiency of the Signal Corps."

Resolved further, That upon the passage of this resolution the Secretary of State be instructed to send forthwith copied thereof to our Senators and Representatives in Congress.

Ratified the 5th day of March, A. D., 1889.

VI. ENTOMOLOGICAL WORK.

Special work has not yet commenced in this branch, though it is the intention of the Station to add in time what is included below:

1. *The identification of insects injurious to vegetation*, and the best methods for their extermination. It is difficult for any one, without a knowledge of the history of insects, to know how to exterminate them. The Station will, when especial work has been commenced, identify any which may be sent for examination, and recommend the best treatment for their riddance.

2. *Publication in the Station Bulletin of the appearance, habit, and growth of injurious insects*, with prevention of their ravages. By investigation of injurious insects, giving their appearance, habits, growth, ravages and methods of prevention, it is expected that the work will be instructive and very valuable. It is impossible to estimate the loss to the State, due to the ravages of insects. It is certain it will reach many thousands of dollars each year. Field and orchard crops both suffer to a great degree. If the Experiment Station can decrease this loss, one of its missions will be accomplished.

VII. EXPERIMENTAL FARM WORK.

a. Field Experiments.—With the close of 1887, owing to decreased appropriations from the State, upon which the Station had depended for its existence, the experimental field work was stopped, and all work at the farm entirely discontinued. The break of a whole season in these operations proved disastrous. Much of the work to be of value must be continuous, and any interruption will be serious. It so proved in this case. With the advent of the Hatch funds from the United States in April of 1888, means were supplied for recommencing work in this special direction. But such had been the interruption in the particular case of this Station that affairs could not be arranged to commence operations until August. Much of the work after this time was preparatory in its nature. Experiments were commenced, however, on the yield of wheat with the various fertilizing ingredients compared with the effect of turning under pea vines; on the value of a new forage plant new to the South—prickly comfrey—which promises well for this climate, so disposed to extended droughts; on the practical operations connected with the preparation of corn ensilage, and other minor work of more or less importance. But these experiments were not finished during the year 1888, and it was consequently thought best to reserve the results for a future publication.

Experiments have been carried on by individual farmers in various counties, mainly in the eastern portion of the State, on the effect of different fertilizing ingredients on the staple crops—cotton, corn, sweet and Irish potatoes, and pea-nuts. This work is new to our people; its value

depending on the fact that, situated at several localities as these experiments are, they not only give results adapted to the different soils, but also afford to the people in those localities means for viewing the details of the work, and discussing the various questions involved therein, as well as to study the results when reached. From our experience for the year 1888, this work, in the main, has been very successful, and will no doubt accomplish much good. The details of these experiments and the comparative results can be seen by reference to heading 4, Co-operative Field Work.

b. Feeding Experiments; and c. Dairy Experiments.—Work in these directions had not commenced in 1888, though much time had been devoted to a thorough preparation for it. A substantial stable for experimental purposes has been erected on the latest pattern to suit this climate, in which arrangements are being made to accommodate ensilage experiments, as well as the experiments in reference to the digestion of certain forage plants, and value as foods in the yield of milk and butter. Laboratory results give us the contents of these grasses and plants, but recourse must be had to practical digestion experiments with stock, to ascertain what proportion of the ingredients contained therein are really digested and utilized by the animal. How much of the food given to stock in the State is more than sufficient to enable them to do what is required? In other words, how much is wasted for want of proper knowledge in feeding? This amount no doubt is very large. To show the most economical method for feeding, will be one of our main works for the coming year.

Likewise, in regard to dairy experiments, there has been erected a well arranged building for this work, which will be equipped with the best implements and machinery for experimental work. The dairy interest in this State is yet in its infancy, but is as vigorous and healthy in this infancy as can be hoped. It will grow at first more quickly nearer the larger towns and cities, where the products can be more easily disposed of; yet it is certain that it will extend to more interior points in a short time. In the vicinity of Raleigh, through the means of energetic citizens, this work is growing surely. This year there will be in the neighborhood of 20,000 pounds of first-class butter made and sold to supply the home demand. A much larger quantity is imported to this city from other States (somewhat over 50,000 pounds), so that it will be some time yet before our home dairies can supply even the Raleigh market, before shipping to other localities.

Our State cannot boast of extensive fields and meadows, nor of any extraordinary growth of grasses and clovers; yet, with the advent of the silo, competition with the dairy interests of other States is rendered not only probable, but certain as well. Certainly, with these facts in view, this State should at least make sufficient dairy products to supply the home market, and after this time it will become better able to compete with others elsewhere. To aid in accomplishing these results, this new departure is made by the Experiment Station, and in doing so is confident of ultimate success.

For a detailed account of the buildings for experimental work, reference must be made to the report of the agriculturist.

VIII. BOTANICAL WORK.

The Station is now well equipped for this work, having a specialist well supplied with all necessary instruments and facilities. This division has a first-class seed collection of 1,200 varieties, containing a complete list of plants, grasses, weeds, etc., both of this country and of Europe, for purposes of comparison and study; microscopes of high and low power, for botanical investigation; apparatus for seed testing, to ascertain their germinating properties; a good herbarium, containing a fine collection of plants found in this State and elsewhere.

Samples of grass and clover seeds found on sale in this State have been examined, a partial report of which has appeared in the Station's *Bulletin*. From this report it has been ascertained that of the samples examined on an average one-half was worthless for planting. This is the plainest evidence for the continuation of this work, and of the value to the farmers. A series of articles, illustrating the value of certain forage plants, in order to encourage diversification of our crops, and for the purpose of increasing home products, has been commenced, and the first installment appeared in the Station *Bulletin*, No. 60.

The botanical work also includes the study of grasses and clovers adapted to this climate, forty-six varieties of which are now under cultivation on the farm.

The following, reprinted from the Station *Bulletin*, No. 58, shows what additional work is contemplated, and will give an idea of its scope:

1. *The Examination of Seeds*, with reference to their purity and capacity to germinate. This work is much needed in exercising a wholesome restraint on the sale of seed in the State. There is room for as much fraud here as there is in the case of commercial fertilizers. How is the farmer, or any one else, to know whether the seed he purchased are free from adulteration and are able to germinate? Of what use is all subsequent cultivation and expensive fertilization if the seed he sows are dead when they reach the ground, or contain weeds or other seeds he does not want?

The Station will commence soon the examination of seeds on sale in the State, and will be able to correspond with persons who desire to have tested the seeds they purchase.

2. *The Identification of Grasses and Weeds*, to ascertain whether it will be beneficial to encourage their growth. Oftentimes grasses are noticed growing wild, which might well be substituted for some we purchase. On the other hand, what we now term weeds might, on examination, prove valuable.

We will gladly examine all samples of grasses and weeds sent to the Station, and report on their value. As grass culture might, with great propriety, be considered one element of a step in the direction towards a material improvement in the agricultural condition of the State, we urge upon the farmers to give the grasses their consideration, and communicate with the Station as to any variety, or to send samples for examination.

3. *Publication in the Station Bulletin, giving description of the growth and properties of all the standard pasture and hay grasses and clovers.* This, it is considered, will be a valuable work and productive of much good. We expect to insert cuts of the various grasses, together with an accurate description of the habits of growth, properties as a cattle food, adaptability to the various sections of the State, as well as statements of practical value from the experience of farmers in this and other States.

For details of work accomplished in this division, reference must be made to the report of the Botanist. Owing to the lateness of time (October, 1888) when the botanical work of the Station was commenced, the report is not so extensive as may be expected in coming years.

REPORT OF THE AGRICULTURIST.*

FARM AND DAIRY BUILDINGS.

The new Stable and Dairy Building at the Farm of the Experiment Station, near Raleigh, were built for the prosecution of experimental work in stock feeding and stock raising, dairying, and storage of forage crops, both cured and by means of silos.

The buildings are located on a gentle incline, as shown by accompanying Fig. A.; the ground sloping faster at the barn than where the dairy is placed. They are about seventy feet apart, being a sufficient distance to secure ample protection in case of fire, yet near enough so that power can be transmitted to the barn from the engine in the dairy by means of a wire cable.

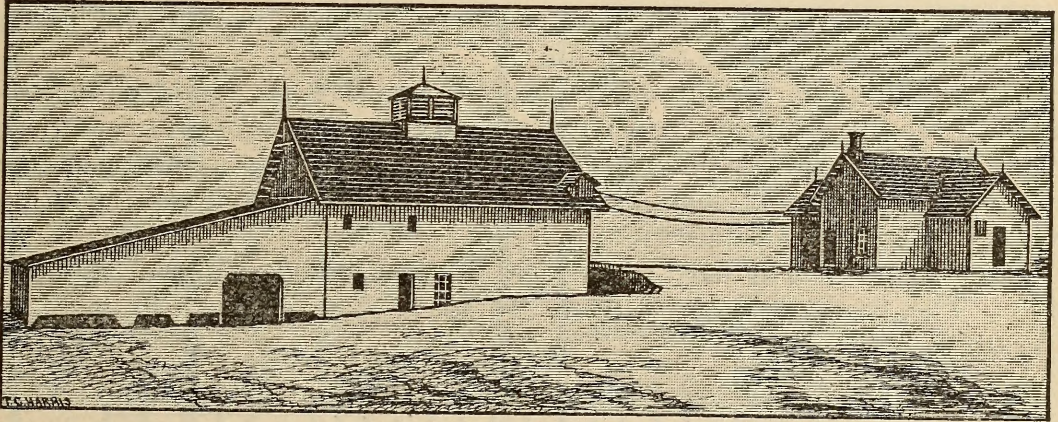


FIG. A.—VIEW FROM SOUTH-WEST.

The north side of the main portion of the dairy building is nearly on a line with the south line of the barn as shown in Figs. A and B. The scale-room, right gable of dairy building, Fig. B, is located nearly in front of the main entrance to the barn, which provides for the convenient weighing of all material, loaded wagons, cattle, etc., to be carried in or out. In order to get as much room as possible under one cover the main barn was built in two stories, or, in other words, there is a main floor and basement. A retaining wall, built ten to twenty feet from the barn, holds the embankment from washing down, and allows the basement to be well lighted and free from dampness. A retaining wall, built a little back from a barn, is a much cheaper and better way than to place a hillside building directly on the wall. The advantage of having light and air from all sides is obvious. At the corner of the barn, directly under the wire cable, Fig. A, are stone steps leading from the upper to the lower level.

*J. R. Chamberlain.

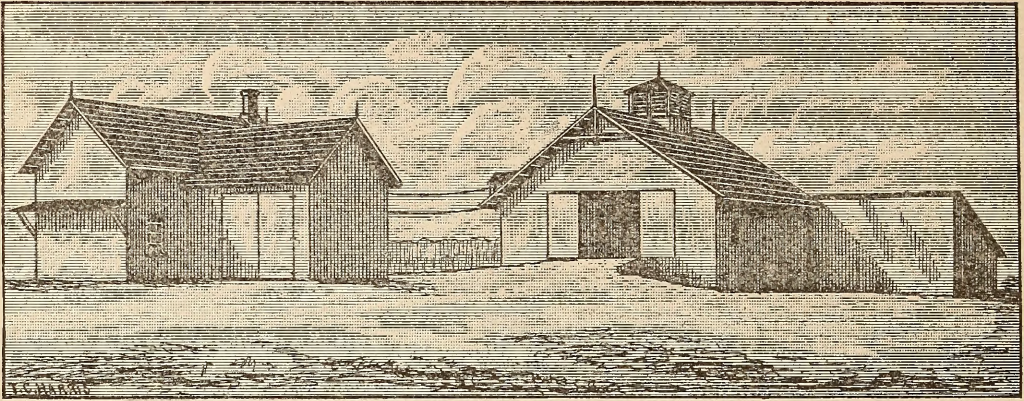


FIG. B.—NORTH-EAST VIEW.

The buildings are inclosed with German siding and painted with oxide of iron, paint and oil. The roof is of shingles, and painted with a mixture consisting of equal parts of finely ground graphite and oxide of iron paint mixed with boiled oil.

These buildings are, in many respects, not such as would be recommended for the ordinary farmer to build, because of the expense entailed. Some of the features explained further on are of such nature that the cost is not disproportionate to the advantages gained, and these may be worthy of careful consideration.

Barn Frame.—The barn is 40 × 50 feet and placed on a brick foundation. The frame, as viewed from the south side, is shown in detail in Figure C.

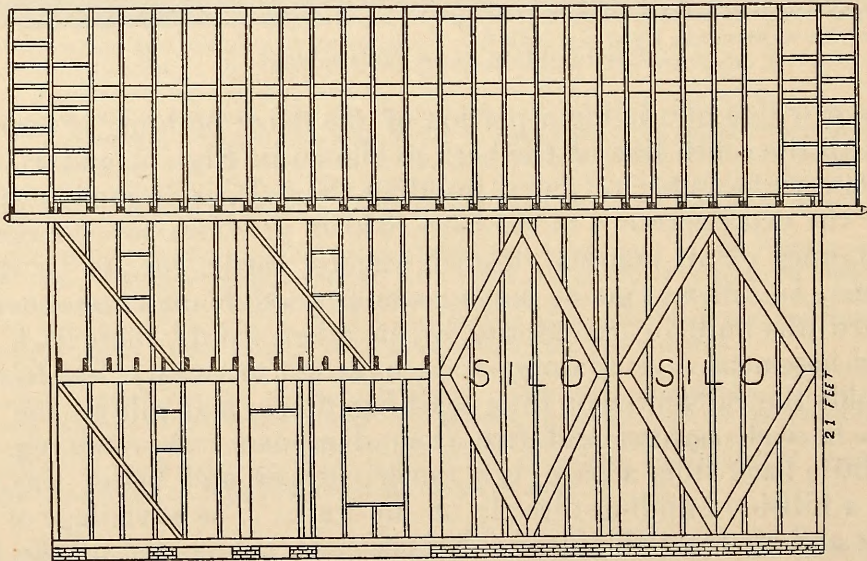


FIG. C.—SOUTH SIDE FRAME OF BARN.

The corner posts and heavy intermediate studs are 6" × 6", 21 feet long. These rest on a sill 6" × 12" with a plate 5" × 8" at the roof. The studs around the silos are cut full length and mortised into the sills and plates; they are 2" × 10", placed 18 inches apart from centre to

centre. This is true of the construction on all sides, including the separation between the silos. The small studs of the barn are $2'' \times 5''$, and the beam running horizontally about even with the word "silo" on the cut, is $5'' \times 8''$. The beams running through the length of the building in the centre of the barn, even with this, and on which rest sleepers for the floor, the ends of which are seen in the cut, are $8'' \times 8''$ and rest on posts. The method of bracing the frame is shown in the cut.

Basement Plan.—The general arrangement can be best understood by examining Fig. D. The sizes given there to the silos are the outside measurements. As stated before, the frame is made of $2'' \times 10''$ studs 20 feet long. On the inside of the frame rough inch boards are nailed as closely as possible horizontally, and on these matched and dressed ceiling is nailed perpendicularly. The ceiling extends past the sills and back wall to the ground, and a cement floor excludes any dampness that might arise from the ground.

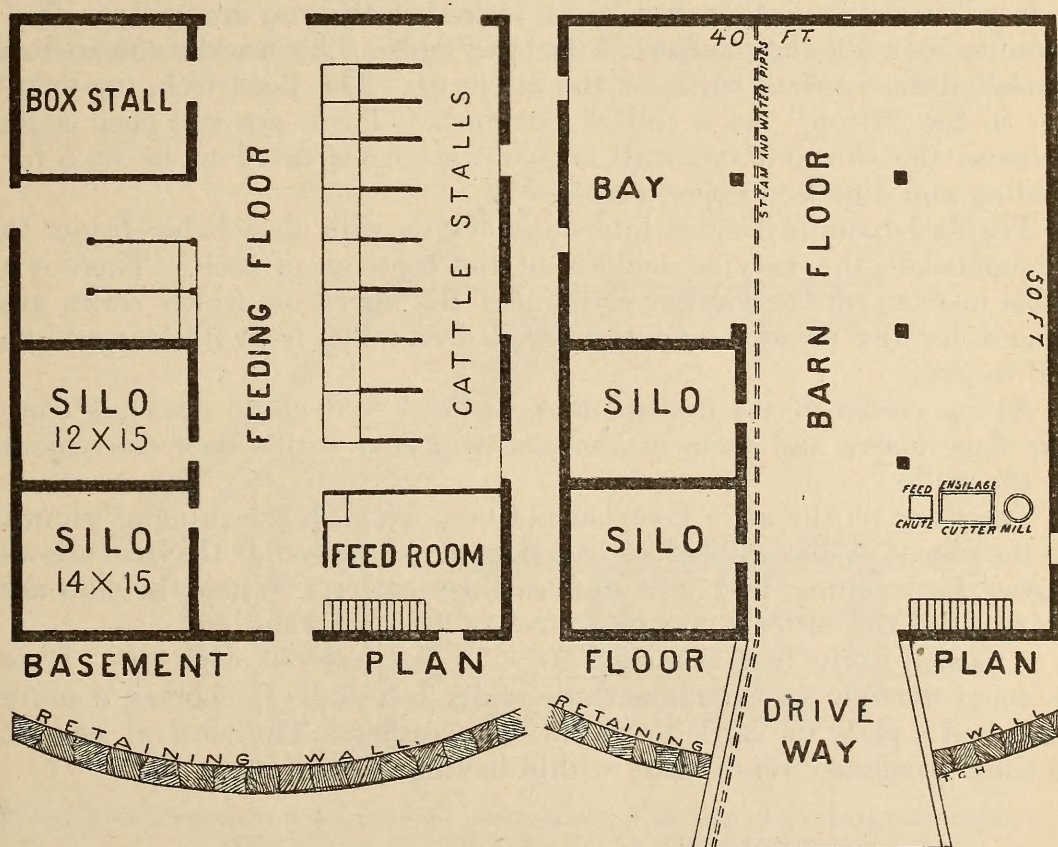


FIG. D.—BASEMENT AND FLOOR PLAN OF BARN.

The remaining portion of the basement has a plank floor, excepting the space behind the cows, which is cemented.

The floor is of two-inch ship-lapped plank, laid on $2'' \times 4''$ scantling. These scantlings are placed in trenches made for them and carefully jointed in. The tops of the scantling are slightly above the surface of the ground, so that there is room for a thin layer of cement to be spread

between them. On these scantlings and into this cement the planks are laid and fastened. This makes an impervious floor, and none of the liquid manure is allowed to escape. The necessity of this is observed when it is remembered that one-half of the fertilizer in the stable is in liquid form. Although a stable floor built as described is rather expensive, yet we can readily see how much more expensive would be that stable so constructed as to save only the solid manure. The liquid manure is needed to supplement the solid excrement with elements in which it is deficient. Of the total excrement, six-tenths of all the nitrogen and nearly nine tenths of all the potash is in the liquid form.

Under a floor made like the above there is no possibility for vermin to nest and multiply. The cement floor behind the cattle slopes toward the open end of the stalls, creating a depression six inches below the level of the stall floor and resting against a 2" \times 6" scantling, sunk two inches in the mortar. This scantling is the limit of the stall floor and the flooring extends over it one inch. The distance from the mangers to the "drop" varies from four feet eight inches at the end toward the feed room to four feet three inches at the other end. This was done to accommodate different sized cattle on the platform. The floor from the manger to the "drop" has a fall of one inch. There are two open stalls between the silo and box-stall, which were constructed to be used for feeding and digestion experiments.

The feed-room is divided into suitable bins with detachable fronts to accommodate the varying heights of the contents of each. There is a table in front of the window and under the stairs, on which scales are placed for the purpose of weighing all feed taken from this room to be fed to stock.

At one corner of the feed-room an inclosed feed chute descends from the floor above and opens on the basement floor with a door convenient to the stalls.

The room on the main floor has not been divided, excepting as shown in the plan. A line of shafting running across the end of the barn allows power for running feed mill and ensilage cutter. When the silos are being filled the cutter is moved for convenience of handling.

Attached to the barn is a shed 50 \times 70 feet, covered with tin. Here is room enough for common cattle stalls, box-stalls for horses, manure shed and a place for cattle to run in bad weather. The shed at present is simply inclosed, no division within having as yet been made.

EXPERIMENTAL DAIRY HOUSE.

The appearance of this building can be well understood from the figures already inserted. The dairy, scale-room and wood and coal-room, attached, are inclosed, and painted in the same manner as the barn.

The frame is a simply built structure, excepting the portion around the cool-room. The sills are $4'' \times 8''$, the plates $2'' \times 6''$, doubled, and the studding $2'' \times 4''$, fourteen feet long, placed sixteen inches apart.

The frame around the cool-room is constructed as shown in Fig. E. The wall has five dead-air spaces, formed by four divisions of building paper nailed perpendicularly, after the manner of the dairy building of the Experiment Station at Cornell University, New York.

In making the paper partitions the paper is cut to half width. The paper is turned half over at each side and nailed with narrow strips or laths to the studs. The two outside paper divisions are made with paper at full width, reaching from top of plate to bottom of sill and lapped on alternate studs. These are fastened by nailing strips $1'' \times 2''$ to the faces of the studding. On these strips are nailed the common siding and matched ceiling boards. It was impossible to make the paper divisions overhead, so it was double ceiled, with space between for saw-dust two inches thick.

The rafters are so framed that air can pass freely upwards between the roof-boards and ceiling and out of slatted windows at either end of the building. By this method the loft is kept cool by a free circulation of air.

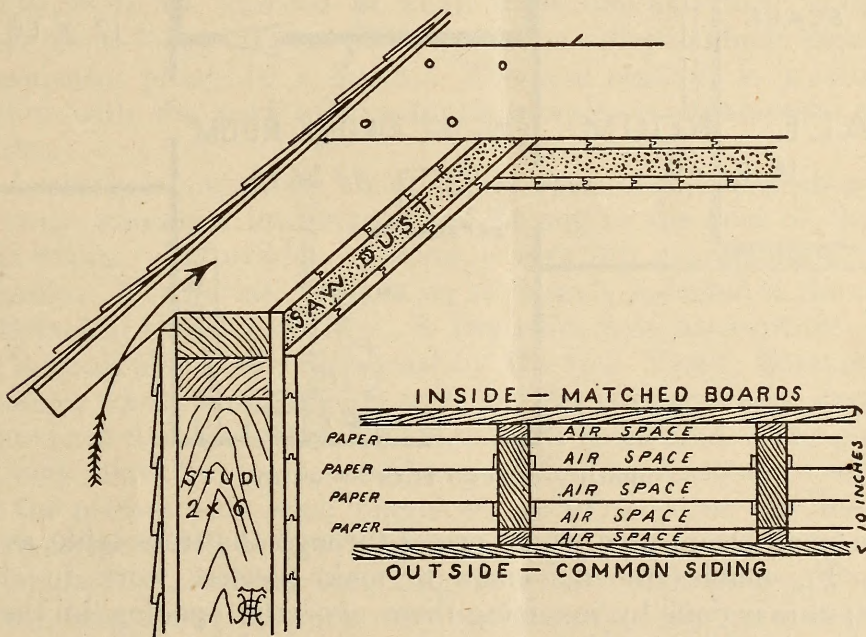


FIG. E.—SECTION SHOWING PLAN OF CONSTRUCTION OF WALLS OF DAIRY BUILDING.
[AFTER PLAN OF NEW YORK EXPERIMENT STATION.]

The rafters are so constructed that air can pass, as indicated by the arrow (Fig. E.), between the roof-boards and the ceiling and out of slatted windows at either end of the building. This allows a circulation of air, which keeps down the intense heat under the roof, and thereby helps to keep the room below cool. In the cool room there is a double window and double door opening as shown in Fig. F.

The inside of the engine and cool rooms is ceiled with matched pine and treated to two coats of boiled oil. The floor is of cement and drains with a rapid descent to traps in a six-inch vitrified sewer-pipe.

The ground plan shows the arrangement and fixtures, so that little need be said in explanation.

The four-horse engine gives power for machinery in barn, pumps the water used in all the buildings, runs the separator and heats the water for washing and steaming utensils.

The washing vat has a cock in one corner where water is obtained, which is heated by steam carried from the boiler through a pipe with a short section of hose attached.

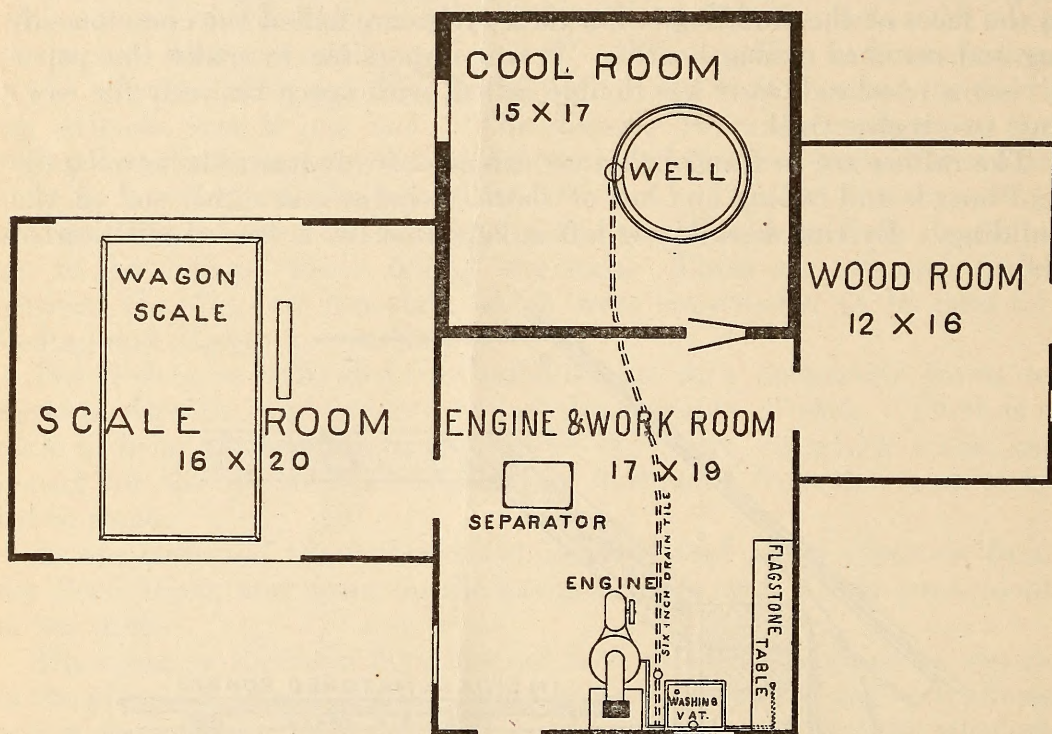


FIG F.—GROUND PLAN OF DAIRY.

"The small steam-pipe which passes through the stone table, as shown in Fig. F., enables the dairyman to make perfect work in cleaning utensils; this is done by inverting them over the opening in the table, where they are filled with the escaping steam and heated to a temperature which destroys all germs and obviates the necessity of wiping them."

The separator used is the horizontal hand-power DeLaval, fitted also for steam power.

There are some features of this building not explained, as they are as yet an experiment. If successful, a more definite publication will be given at a future date.

REPORT OF THE BOTANIST.*

The Botanical Division of the Station having been established only since October 1, 1888, much of the work already accomplished has necessarily been of a preparatory character. A large, well-lighted room on the third floor of the Agricultural Department building has been fitted up with all appliances necessary for botanical investigations.

The apparatus used in the botanical work of the Station include besides various minor pieces, the following, viz.:

1. A collection of labeled seed samples.
2. A collection of dried plant specimens.
3. Two microscopes with accessories.
4. A seed sprouting apparatus.
5. An analytical chemist's balance.
6. A reference library.

The seed museum contains about 1,500 different kinds of seeds, including seeds of all the plants, whether useful or noxious, known to agriculture. The seeds are enclosed in small tubes one-half inch in diameter and three inches long. Recent additions to the collection have been put up in homeopathic phials 10×80 cm. The seed museum is invaluable in connection with the work of examining samples of commercial seed for impurities.

The herbarium comprises about 2,500 species, chiefly such plants as are of some economic importance and belong to the flora of the South Atlantic States. It includes, however, a very full representation of the grass family. For the latter plants we are largely indebted to the courtesy of the Botanical Division of the U. S. Department of Agriculture. These grasses were all identified and labeled by Dr. Geo. Vasey, Botanist to the Department, whose authority on such matters is everywhere recognized. The plants are therefore very valuable as type specimens. The plant collection may hereafter be increased to include a representative collection, but for the present only such plants as are of more or less interest to Southern farmers will be provided for.

The plants are arranged according to a new and labor-saving plan, which we have found to work very satisfactory. By this method the poisoning of the specimens and mounting on heavy paper is dispensed with. The dried specimens with their labels are laid between double sheets of strong unsized manilla paper 11×17 inches. The paper had previously been soaked in a boiling solution of white arsenic and wash-

*Gerald McCarthy.

ing soda—four parts arsenic and five parts soda dissolved in thirty-five parts distilled water, and boiling. The sheets are allowed to dry thoroughly before the plants are put in. The specific name of the plant is written on the lower right hand corner of each sheet; the species are then arranged in alphabetical order and inclosed in a genus cover of different colored paper. The name of each genus is written on the lower right hand corner of the genus sheet, together with its serial number according to Chapman's Manual; or for foreign species Bentham & Hooker's *Genera Plantarum*. The genera are then grouped into natural families, and each group inclosed in an order-cover with the name and number of the order written on the lower left hand corner. The orders are then placed in stout muslin-covered pasteboard boxes $12\frac{1}{2} \times 18\frac{1}{2} \times 6\frac{1}{2}$ inches. A small piece of naphthaline is placed inside of each box to aid in repelling insects and vermin. So far no losses or trouble has been occasioned by these pests. Plants kept in this way retain their natural colors very well; they are easy to handle and examine, and the labor of arranging the collection is not a tithe of that involved by the old way. The microscopes used are a Zentmayer botanical, and a Bausch & Lomb universal compound, with accessories for section cutting, mounting, etc. The compound instrument has magnifying powers ranging from 50 to 960 diameters.

The seed sprouting apparatus used is Nobbe's. This consists of porous earthenware pans glazed only on the bottom. They are eight inches square and one and one-half inches thick. In the centre of each pan is a circular depression one-half inch deep and five inches in diameter. Surrounding this is a ring or fosse one inch wide and one inch deep. The seeds to be tested are put into the central depression and water poured into the fosse. The water soon soaks through the porous earthenware, producing a dew-like deposit on the surface of the seed dish. This supplies just enough moisture for most seeds while not enough to drown any. For larger seeds, such as beans, corn, etc., the moisture supplied to the seed dish is not sufficient, but such seeds sprout readily, if of good quality, when placed in the fosse and the water poured into the dish. The whole pan, as described, has a loosely fitting cover which admits air while excluding light. This apparatus is the invention of Dr. Frederick Nobbe, of the Thorandt (German) Experiment and Seed Control Station. It gives very good satisfaction where only a small amount of seed testing is done, but takes up too much room to be extensively employed.

The balance used for weighing seeds and impurities found in seed samples is one of Becker & Son's best instruments. It is sensitive to $\frac{1}{10}$ milligram and gives entire satisfaction.

The library appertaining to the division includes most of the standard works relating to economic botany and horticulture.

All things considered, we believe we have one of the best equipped botanical laboratories in the country.

Of the practical work accomplished since the establishment of the division the following is a record:

1. A large number of specimens of grasses and weeds have been iden-

tified for citizens, and numerous letters written concerning the same, and also to inquiries as to the grasses best suited to particular localities, etc., etc.

2. On October 7th, 1888, there were sown at the Experiment Farm forty-six plots, 3×6 feet, with different grasses and clovers, for the purpose of comparing the behavior of different kinds when grown side by side, and discovering what species promise most for our soils and climate.

The following is a list of the grasses and clovers grown :

Kentucky blue grass.....	<i>Poa pratensis.</i>
June grass.. .. .	<i>Poa compressa.</i>
Fowl meadow	<i>Poa serotina.</i>
Wood meadow	<i>Poa nemoralis.</i>
Rough stalked meadow	<i>Poa trivialis.</i>
Water meadow	<i>Poa aquatica.</i>
Meadow fescue .. .	<i>Festuca pratensis.</i>
Randall grass	<i>Festuca elatior.</i>
Hard fescue.....	<i>Festuca durinsecula.</i>
Sheep's fescue.....	<i>Festuca ovina.</i>
Fine-leaved fescue.	<i>Festuca tennifolia.</i>
Rescue grass.....	<i>Bromus Schraderi.</i>
Soft brome.	<i>Bromus mollis.</i>
Meadow brome	<i>Bromus pratense.</i>
Orchard grass	<i>Dactylis glomerata.</i>
Crested dogtail grass	<i>Cynosurus cristatus.</i>
Tufted hair-grass.....	<i>Aira caespitosa.</i>
Slender hair-grass.....	<i>Aira flexuosa.</i>
Tall oat grass	<i>Arrhenatherum avenaceum.</i>
English rye grass.....	<i>Lolium perenne.</i>
Italian rye grass.....	<i>Lolium Italicum.</i>
Couch grass.....	<i>Triticum repens.</i>
Bermuda grass	<i>Cynodon dactylon.</i>
Beach grass	<i>Ammophila arenaria.</i>
Johnson grass	<i>Sorghum holopense.</i>
Hungarian millet.....	<i>Setaria Italica.</i>
Reed grass	<i>Phalaris arundinacea.</i>
Annual sweet vernal grass.....	<i>Anthoxantum puelli.</i>
Perennial sweet vernal grass	<i>Anthoxantum odoratum.</i>
Timothy grass.....	<i>Phleum pratense.</i>
Meadow foxtail grass	<i>Alopecurus pratensis.</i>
Velvet grass.....	<i>Holcus lanatus.</i>
Slender foxtail grass	<i>Alopecurus agrestus.</i>
Fiorin	<i>Agrostis Stolonifera.</i>
Red-top	<i>Agrostis vulgaris.</i>
Brown bent grass.....	<i>Agrostis canina.</i>
Japan clover	<i>Lespedeza striata.</i>
Lucerne.	<i>Medicago sativa.</i>
Bokhara clover.....	<i>Melilotus alba.</i>
White clover	<i>Trifolium repens.</i>

Mammoth clover.....	<i>Trifolium pratense, perenne.</i>
Crimson clover.....	<i>Trifolium incarnatum.</i>
Red clover	<i>Trifolium pratense.</i>
Alsike clover	<i>Trifolium hybridum.</i>
Yellow trefoil clover.....	<i>Medicago lupulina.</i>
Sanfoin	<i>Onobrychis sativa.</i>

It is still too early to hazard any opinion on the relative merit of these various species of forage plants.

Since October 1, the Botanist has prepared and the Station has published two Bulletins. The first, No. 59 in the Station series, dealt with the Purity and Vitality of Seeds. The second, No. 60 in the Station series, discussed the value of Lucerne as a Forage Plant.

THE PURITY AND VITALITY OF SEEDS,

WITH RECENT TESTS OF GRASS AND CLOVER SEED SOLD IN NORTH CAROLINA.

Except in regard to the larger sort of seeds, such as cotton, corn, peas, etc., the seeds of field crops are rarely sold entirely free from an admixture of weed seeds. Indeed, most of the weeds now so troublesome in our cultivated fields are European plants, which were originally introduced and widely disseminated in packages of imported seeds. While the entire exclusion of weed seeds from packages of clover, grass and small grain seed is not to be expected, the farmer is justified in demanding that the real worth of the seeds he purchases shall come up to a reasonable standard. A number of samples of grass and clover seeds recently tested at this Station fall so far below such a standard as to convey the impression that they must have been adulterated, with fraudulent intent, by the seed growers. The seeds of no two species of plants are exactly alike in size and weight; and, since manufacturers now supply automatic cleaning machinery of very great perfection, there can be no valid excuse for putting upon the market such seed, for instance, as a sample of Red-top examined, which contained 37.50 per cent. of impurities; and of the pure seed only fifty-three per cent. were capable of sprouting; or, in other words, in the sample there were only 44.92 per cent. of pure vital, that is to say, valuable seed. Carelessness on the part of the grower, and a desire to furnish cheaper seeds than competitors, have much to do with the marketing of such impure and semi-worthless seed. The seedsmen are, however, not wholly to blame in this matter. So long as farmers and gardeners demand cheap seeds, regardless of quality, just so long will persons be found to cater to the demand,

even though they are obliged to debase the quality to make up for the low price. Very cheap seeds should be always viewed with suspicion. They are usually the most expensive things that the farmer can buy.

Concerning cheap seeds Dr. William Carruthers, botanist to the Royal Agricultural Society of England, in a report to that body, remarks:

"It is impossible to estimate the injury that an agriculturist does to himself when to save a few shillings in the spring by purchasing inferior seed, he insures at harvest a crop not only poor in itself, but abundantly mixed with seeds of worthless and noxious weeds, whose injury to his crops does not end when they are cut down with the grain. In buying dirty seed he is acquiring material which may prove a serious injury to his crops for years to come."

The Southern farmer who buys such seed loses not only the money he invests in the purchase of seed and fertilizers, and in the preparation of the land, but also the value of the increase he might reasonably have expected. But this is not all. The cost of eradicating the weeds whose seeds he has unwittingly sown, and the injury they do to his succeeding crops, must also be considered. One sample of clover seed recently examined at this Station contained five per cent. of Dodder seeds. The Dodder is a parasitic plant which feeds upon the juices of cultivated plants. It is extremely difficult to get rid of when once introduced into a field. Its seed have been known to sprout after having been buried in the earth for four or five years.

The following standard of purity and vitality of agricultural seeds has been established by the Royal Agricultural Society of England:

1. That 95 per cent. by weight of the seed shall be true seeds of the species claimed.
2. That of the pure seed not less than 90 per cent. shall be capable of sprouting in the case of the clovers, the cereals and Timothy grass. Of Foxtail grass not less than 20 per cent., and of all other grasses not less than 70 per cent.

English seedsmen now guarantee their seeds in accordance with this standard, and in consequence debased seeds are very rarely found in the English home market. A similar state of affairs prevails in Germany. English and German seedsmen are permitted to export impure seeds, and much adulterated seed thereby reaches our shores. The Germans, as a nation, are noted for their thoroughness in everything. When they undertake to adulterate seed they do it with characteristic perfection. There is in the seed museum of the Station a phial of artistically colored quartz grains, used by German seedsmen to adulterate clover seed, and detected by the Station in clover seed on sale in this State.

The following is the method in use in the North Carolina Agricultural Experiment Station for determining the quality of seeds:

The seed is taken from the package in which it reaches the Station and thoroughly mixed. A sample of from one to four grams, according to the size of the seed, is taken and weighed in a delicate chemical balance.

It is next poured into a sectional tin tube, three and a half inches in diameter and twelve inches long. The bottoms of the section, five in number, are perforated with holes graded from two millimeters ($\frac{1}{12}$ th inch) in diameter at the top to 0.50 m. m. ($\frac{1}{50}$ th inch) at the bottom. By shaking the tube the mass of seed is separated into several portions. The sticks and coarse impurities are found near the top, while sand and half grown and shriveled seeds fall near the bottom. The bulk of the pure seed is found together. The several portions are then separately spread out on sheets of clean paper and examined with a microscope. Any good seeds that may have escaped the separator are picked out of the mass of impurities by means of a forceps. Seeds of noxious weeds are carefully looked for, identified and their number noted where practicable.

After the true seeds have been separated from the impurities the latter are again weighed and the per cent. they bear to the whole sample calculated.

One hundred true seeds, taken without selection, are next counted out and placed in one of the seed dishes of Nobbe's Seed Sprouting Apparatus. As soon as any seeds have sprouted they are counted and removed from the dish and the day and hour noted. When, after several days, no more seeds are found to sprout, or when the unsprouted seeds show signs of decay and become covered with mold, they are counted as dead and the experiment is completed. The number of seed which have sprouted, when 100 seed have been experimented with, indicate the percentage of vitality of the pure seed in the sample. In calculating the worth of a sample of seed we must consider both the percentage of impurities and that of vitality of pure seed.

The following transcript of a page from the Botanist's record-book will show at one glance how the work is done:

STATION NO. 5133. ORCHARD GRASS—(*Dactylis glomerata*).

Purity Examination:

Weight of sample.....	2.000	grams.
Weight of impurities.....	0.305	"
Per cent. of impurities.....	15.250	
Nature of impurities.....	sticks, chaff	and weed seeds.

Germinating test:

Oct. 24.	Put in pan VI,	100	seeds.		
" 28.	1st seed sprouted.				
" 29.	Took out.....	13	sprouted seeds.		
" 30.	" "	5	" "		
Nov. 2.	" "	28	" "		
" 5.	" "	7	" "		
Total.....		53	" "		

Vitality of pure seed fifty-three per cent. Per cent. of pure vital seed in sample 44.92.

Remarks: The vitality of pure seed in this sample is too low. English standard for this grass is seventy per cent. of pure seed. The sample was very dirty.

In the manner shown, the following seeds were examined and tested, but only the results are here given:

STATION NO. 5132. TALL OAT GRASS—(*Arrhenatherum avenaceum*).

Per cent. of impurities. Trace.

Nature of impurities Chaff and sticks.

Per cent. pure seed capable of germinating..... 78.

Per cent. of pure vital seed in sample..... 77.

Remarks: Good seed.

STATION NO. 5134. RED-TOP GRASS—(*Agrostis vulgaris*).

Per cent. of impurities..... 15.25.

Nature of impurities... Sand and fragments of brick, chaff, sticks and weed seeds.

Per cent. pure seed capable of germinating 53.

Per cent. of pure vital seed in sample..... 44.92.

Remarks: Sample very dirty. Besides a great number of Timothy seeds the following were identified: knot weed, 3; sorrel, 6; chess, 3.

STATION NO. 5135. TIMOTHY GRASS—(*Phleum pratense*).

Per cent. of impurities..... Trace.

Nature of impurities Chaff and sticks.

Per cent. pure seed capable of germinating 33.

Per cent. of pure vital seed in sample. .. 32.

Remarks: This sample was very clean. Vitality very low. English standard for this grass, ninety per cent.

STATION NO. 5136. ITALIAN RYE GRASS—(*Lolium Italicum*).

Per cent. of impurities..... Trace.

Per cent. of pure seed capable of germinating 94.

Per cent. of pure vital seed in sample..... 93. +.

Remarks: Very clean and good seed.

STATION NO. 5140. KENTUCKY BLUE GRASS—(*Poa pratensis*).

Per cent. of impurities..... 5.

Per cent. of pure seed capable of germinating..... 8.

Per cent. of pure vital seed in sample 7.60

Remarks: Seed almost worthless.

STATION NO. 5139. RED CLOVER—(*Trifolium pratense*).

Per cent. of impurities..... 5.

Per cent. of pure seed capable of germinating..... 83.

Per cent. of pure vital seed in sample..... 78.85.

Remarks: Vitality of pure seed slightly below the English standard, which is 90 per cent. Sample infested with Dodder seeds.

STATION NO. 5138. ALSIKE CLOVER—(*Trifolium hybridum*).

Per cent. of impurities.....	17.50.
Per cent. of pure seed capable of germinating.....	77.
Per cent. of pure vital seed in sample.....	63.52.

Remarks: Very dirty. Contains sand and quartz, Dodder and Timothy seeds.

STATION NO. 5137. WHITE CLOVER—(*Trifolium repens*).

Per cent. of impurities.....	7.50.
Per cent. of pure seed capable of germinating.....	67.
Per cent. of pure vital seed in sample.....	61.97.

Remarks: Vitality very low for clover seed.

LUCERNE.

ITS VALUE AS A FORAGE CROP.

Probably no other plant has during the last few years awakened such a widespread interest among Southern farmers as lucerne. This plant promises to be of incalculable value to the cotton and tobacco planter by enabling him to diversify his crops and raise more meat, milk, butter and wool. The engraving opposite this page conveys a good idea of the appearance of a lucerne plant.

Lucerne, together with the other medics, melilots and clovers, belongs to the trefoil tribe of the great pulse family of plants. To this family belong also all our field and garden beans, peas, pea-nuts, lupines and as well as many medicinal and ornamental plants. The scientific name of lucerne is *Medicago sativa*. *Medicago* is an adaptation of the word *Media*, the name of the country in which lucerne was first cultivated, and from which it was introduced into Greece more than 2,000 years ago. *Sativa* is a Latin word meaning cultivated or tame. In California lucerne is more commonly called by its Spanish name, Alfalfa.

Lucerne may be distinguished from all other plants by the following description:

Flowers in form very like pea flowers, and arranged in slender spikes. Purple, violet or blue in color. Seed pod very narrow, twisted spirally about twice around. Seeds several in each pod. Leaves compound and trifoliate, very like those of white clover; oval or oblong, with the broadest end upwards; toothed on the margins. On good soils lucerne grows to a height of two or three feet. It may always be known from the melilots and clovers by its spirally twisted pods. All the plants of the pulse family are great lovers of lime and will do their best only on soils containing a considerable amount of this mineral. Soils naturally deficient in lime must be supplied with it artificially in the form of oyster shells, marl, gypsum, bone or quicklime, before the best results can be attained either with lucerne or clover.

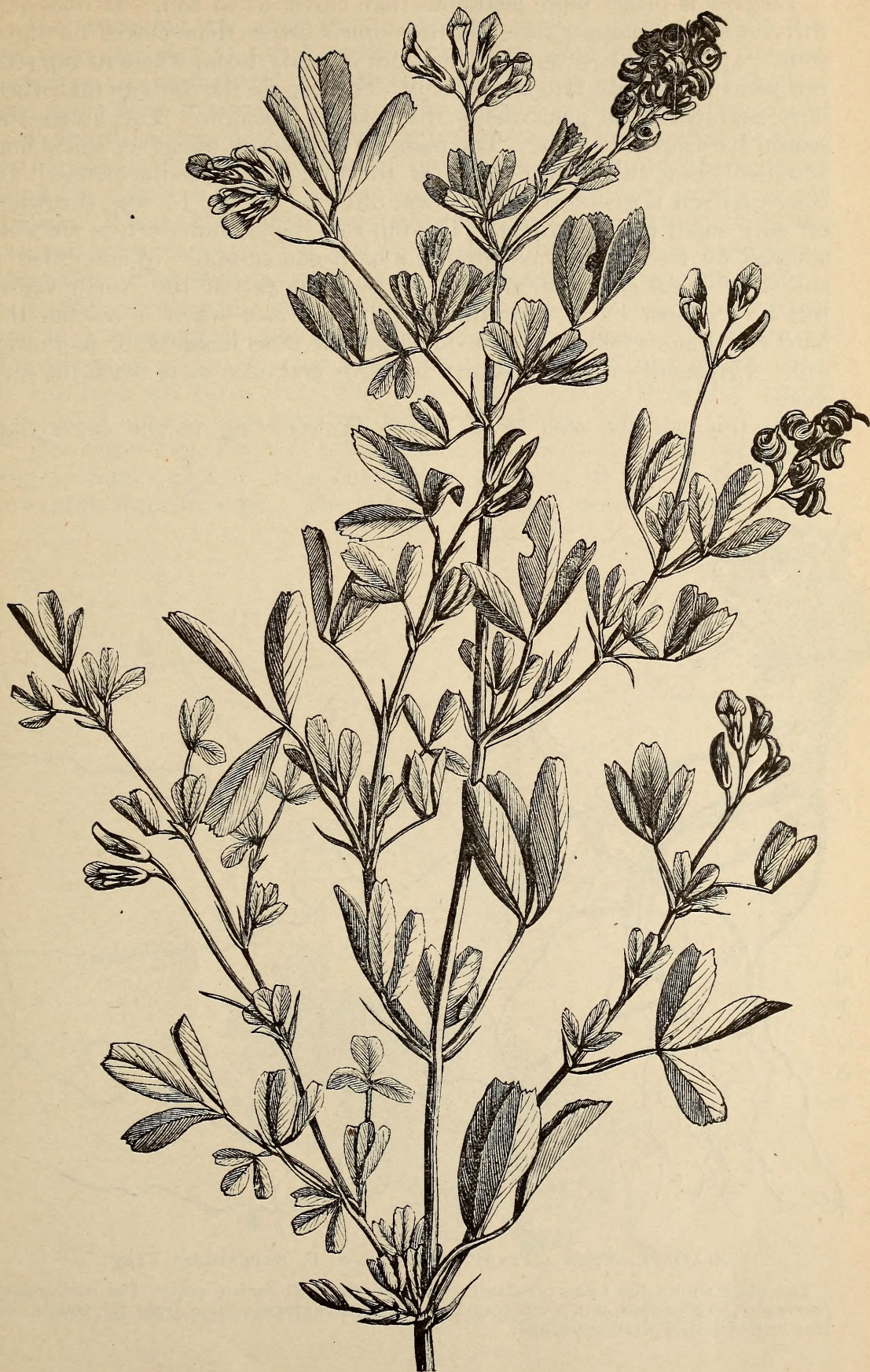


PLATE I.—LUCERNE.

Lucerne is rather more fastidious than clover as to soil. It does not thrive well on compact clay, but does much better than clover on light soils. It does its best on light, deep, dry, sandy loam, where its tap root can penetrate deeply into the subsoil. So deep do the roots go that when once established the plant defies the severest drought. The hotter the season the faster it grows. The main or tap root is about as thick and succulent as a full-grown carrot at the top, but is smaller below. In congenial soil it grows straight down, often for 10 to 15 feet, throwing off only small lateral feeders. The tap root, being quite soft, is not well adapted for forcing its way through a hard-pan subsoil. Where such a subsoil is found very near the surface, as is the case at the North Carolina Experiment Farm, near Raleigh, the tap root when it reaches the hard clay glances off and sends off large side roots in search of mellow soil. Frequently these roots turn upwards and once more reach the surface.

All this will be seen at a glance by referring to the engraving, Plate II.

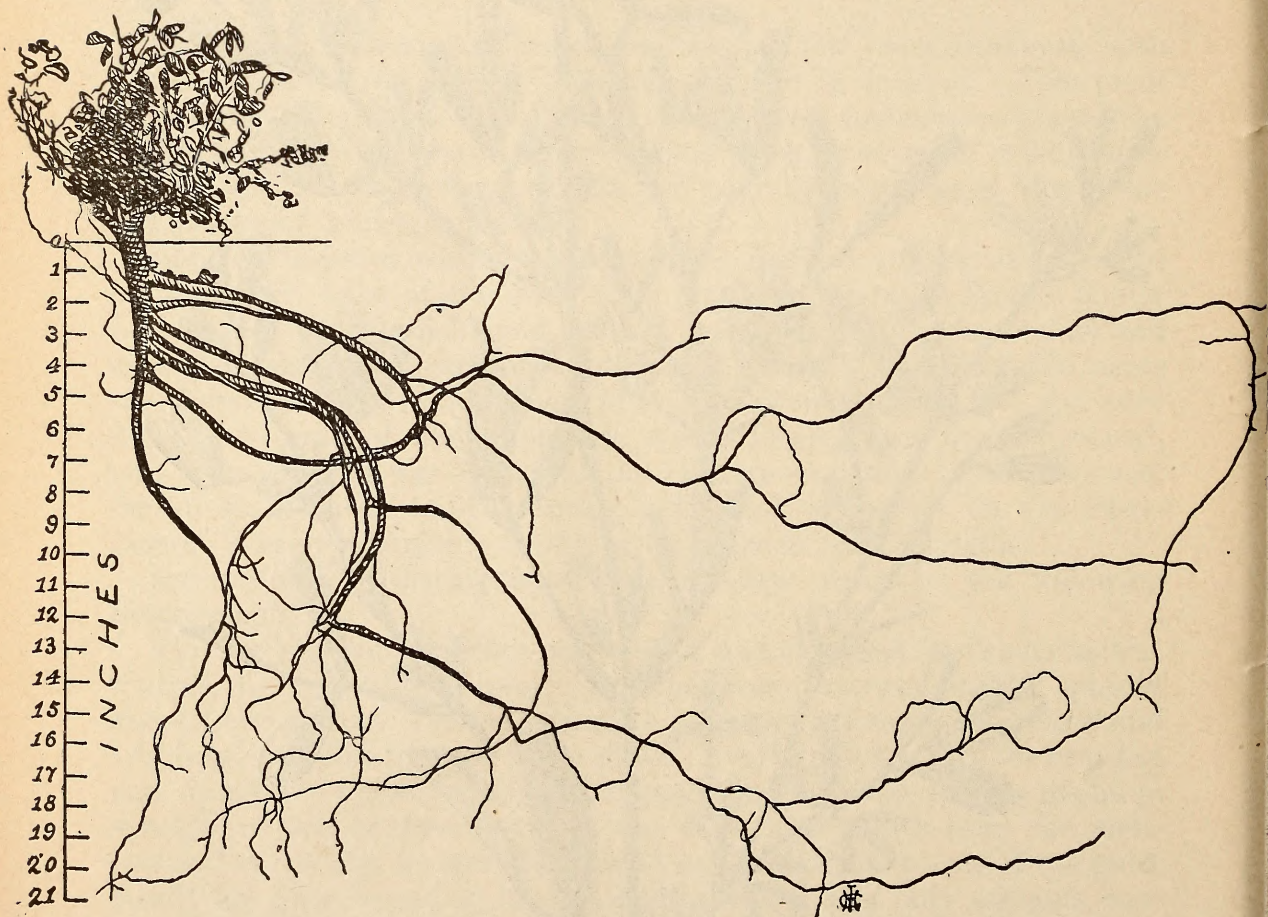


PLATE II.—FROM A PLANT GROWN ON N. C. EXPERIMENT FARM.

The plate shows the roots penetrating to a depth of 21 inches only. The roots really penetrated to 26 inches, but it was found impossible to extricate them from the tough, red clay in which they were imbedded.

The engraving was made from a photograph of a plant carefully dug up from the plot at the Experiment Farm. The subsoil at eighteen inches was so hard that a mattock had to be used to loosen it. The plant was taken from the end of a row. The engraving shows how the lateral roots are all on one side, striking out into the unoccupied soil of a neighboring plot. The lateral spread of the roots was about four feet. Most of the root system, as will be seen, was found within ten inches of the surface. The soil had been thoroughly broken up to that depth before the seed were planted. The plot from which this plant was taken is two years old. The seed was sown in drills fourteen inches apart in September, 1886. Owing to a lack of funds the work on the Experiment Farm had to be suspended from December, 1887, to August, 1888, hence no figures can be given as to the exact yield of the plot during this time. It has been cut three times this season, and is now, December 1st, in very good form to give a cutting before March 1st, 1889.

The engraving, Plate III, was made from a photograph of a plant dug up from a plot of about one acre on the farm of Dr. R. H. Lewis, two miles from Raleigh. The soil of this plot is very compact red clay.

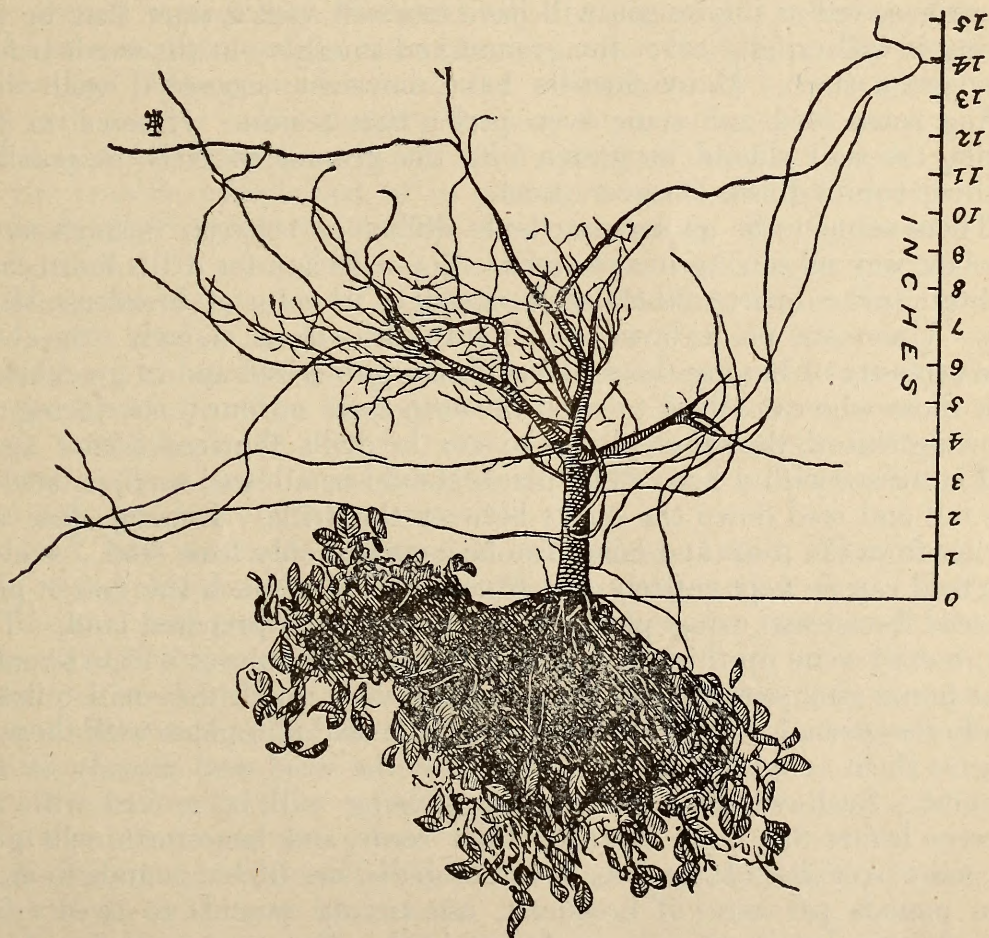


PLATE III.—FROM A PLANT GROWN ON THE FARM OF DR. R. H. LEWIS.

It was so hard that a spade could make no impression on the ground, and a mattock had to be used to loosen the soil, even on the surface. This plot is of the same age as the one on the Experiment Farm, but was sown broadcast. The stand is very good and no weeds were to be seen in the field. This field has been mowed three times this season and yielded well according to the estimate of Dr. Lewis' manager, Mr. J. H. Davis. As will be seen by referring to the engraving, Plate III, the extreme depth reached by the roots is fifteen inches. Most of the roots are found within eight inches of the surface. Upon such soils as those found on the Lewis place and the North Carolina Experiment Farm lucerne is far from drought-proof, nor can the enormous yields it gives under more favorable circumstances be realized. Under the most favorable circumstances a well established lucerne meadow will yield fifteen to twenty tons of green fodder, equal to four or five tons of dry hay, per acre. Under such circumstances the duration of the meadow is indefinite, but under favorable conditions it will yield well for ten or fifteen years. In the latitude of North Carolina the best time to sow lucerne seed is during September. Most of our troublesome weeds are annuals, and by September they have completed their growth for the season. Lucerne sowed at this season will have received such a start that in the spring it will rapidly cover the ground and smother out the weeds before they get a start. Many farmers have, however, succeeded well with spring sown seed and some even prefer that season. If sown in the spring the seed should be gotten into the ground as early as possible without running risk of severe frost.

There seems to be an irreconcilable difference between farmers as to the best way of sowing lucerne seed. Some declare for drills fourteen to eighteen inches apart; others are as strongly in favor of broadcast seeding. Upon one point, however, all authorities agree, namely: the absolute necessity of having the seed-bed finely pulverized and in good heart. For those who can afford to weed the crop three or four times during the growing season, the safest plan is to sow in drills fourteen inches apart and cultivate with a hoe. The plants should be allowed to ripen seed in the fall and seed down the spaces between the drills. Lucerne does not sucker from the roots and hence can be increased only from seed. Unless the field can be kept entirely free from weeds it is much the better plan to seed broadcast, using plenty of seed, upon well prepared land. The plants will come up thickly, and as good seed will sprout within twenty-four hours after sowing, and the growth is very rapid, they will quickly shade the ground. It is well to sow a little acid phosphate with the seed to give them an additional advantage over the weed seed already in the ground. Such weeds as succeed in growing will be moved with the lucerne before they have matured their seeds, and henceforth will give no more trouble. If seed is sown in drills, use fifteen pounds to eighteen pounds per acre; if broadcast, use twenty pounds to twenty-five pounds, the larger amount on heavy land. For the proposed meadow select the best cotton land on the farm. Turn off a furrow as deep as possible and then follow in same furrow with the bull tongue or a sub-

soil plow, and so on through the field. Most North Carolina soils are deficient in lime, and unless the farmer prefers to use ammoniated superphosphate or bone meal in generous doses it is best to spread broadcast upon the plowed land 1,000 lbs. to 1,500 lbs. of quicklime per acre. Harrow it in with the Thomas or some similar smoothing harrow, going twice over the land—the second time at right angles to the first. Quicklime not only supplies a mineral demanded by lucerne and clover, but by its well understood and vigorous solvent action it breaks up many insoluble compounds in the soil, rendering their constituents available for immediate consumption by the roots of the plant. It acts further by chemically pulverizing the soil finer than can be done by any mechanical process. The lime should be harrowed in a few days before the lucerne is sown so that it may have had time to lose its heat before the seed comes in contact with it in the soil. Freshly burnt quicklime costs at Norfolk \$2.25 per ton, in bulk, free on board cars.

The seed should be wetted and as much acid phosphate as they will hold dusted upon them just before sowing. Seed thus treated should be rolled in, but will require no further covering unless the weather be unusually dry. In the latter case a light brush harrow may be used and the ground immediately afterward rolled, using a light roller upon sandy soil and a medium weight upon heavier land. Rolling is very beneficial to the seed if the ground is at all dry. The rains we have in spring and fall will usually suffice to carry the seed down as far as necessary. Lucerne seed will not sprout if covered deeper than one-fourth inch. Much of the trouble complained of in getting a good stand of lucerne has undoubtedly been caused by covering too deeply, thereby causing the seed to rot. No toothed harrow should ever be used to cover lucerne seed.

The greatest care should be exercised in selecting seed. The vitality of lucerne seed is so low that seed over one year old is scarcely worth sowing. Two sprouting experiments with this seed were recently made at the North Carolina Experiment Station. In each experiment 100 seeds were taken. In the first case six seeds only sprouted; in the second twelve. These seeds were brought to the Station in September, 1886, and were presumably three years old.

Good, well matured lucerne seeds are kidney-shaped, about twice the size of red clover seed. They are of a brownish-yellow hue. Samples of lucerne seed containing many blackish seeds, or very small whitish ones, should be rejected. The black ones have been over-heated, the small one are immature. Since lucerne is a sun-loving plant, seed grown in hot climates is apt to have more vitality than that from colder regions. California seed is reputed better than Eastern grown seed. Seed should be purchased only from reliable growers, and only the best quality is worth purchasing at any price.

As lucerne has been cultivated from time immemorial, many estimations of its value have been made.

One of the most recent and best analyses of lucerne was made by the New Jersey Experiment Station in 1887, and is herewith subjoined. (Table 7):

TABLE 7.—COMPOSITION OF LUCERNE.

	Tonnage per Acre.	POUNDS, PER HUNDRED OF						PERCENTAGE OF		
		Water.	Fat.	Fiber.	Ash.	Proteine.	Carbohydrates	Nitrogen.	Phosphoric Acid	Potash.
Total tonnage per acre and average composition of green crop....	20.79	80.34	0.83	4.51	2.07	3.82	8.44	0.61	0.11	0.69
The same, computed on the Hay basis.....	4.44	7.70	3.89	21.17	9.80	17.93	39.62	2.90	0.52	3.24
Average composition of Clover Hay.....	.....	7.70	2.08	28.20	6.80	12.46	42.77	1.99	0.36	1.68
Average composition of Wheat Bran.....	.....	11.95	3.70	.....	5.70	16.50	62.14	2.36	3.14	1.68

The sample of lucerne from which the above analysis was made was of one year's growth from seed.

The same report contains the following remarks upon the feeding value of lucerne:

"For feeding purposes it is practically identical in chemical composition with the best wheat bran. A ton of bran contains nine times as much phosphoric acid as a ton of lucerne hay, but a ton of the hay contains twice as much potash as a ton of bran. * * * If twenty-five pounds of such hay were fed daily to a cow of 1,000 pounds live weight said cow would consume the following amount of digestible food: 2.99 pounds* of proteine, 0.29 pounds of fat and 9.03 pounds of carbohydrates. A ration as near the theoretical standard as practical men would consider desirable. It seems reasonable, then, that lucerne may be used to the exclusion of other feeding stuffs. If twenty-five pounds of lucerne hay, or its equivalent in green fodder, will support a cow for one day, one acre of lucerne, yielding 4.40 tons of hay, will support a cow one year."

The greatest value of lucerne is as a food for milch cows. It will be much prized by suburban dwellers and inhabitants of small towns. A patch of one acre with a very little grain will keep one cow in good condition the year round. Every one, then, who can control that much land may supply himself with abundance of pure and wholesome milk and butter at a very small cost. For the farmer who wishes to raise his own bacon, lucerne is nearly as valuable. Besides furnishing a rich food for swine it is considered an excellent preventive of cholera. Sheep eat lucerne in preference to clover and keep remarkably healthy upon it. One acre will support six sheep the year round.

*An error accidentally crept in the report of the N. J. Experiment Station. The above figures are different, therefore, from those printed in the report.

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION

IN ACCOUNT WITH

THE UNITED STATES APPROPRIATION.

1888.		Dr.
To receipts from Treasurer of the United States, as per appropriation for year ending June 30, 1888, under act of Congress approved March 2, 1887.....		\$15,000 00
		Cr.
June 30. By wages.....	\$ 851 39	
" salaries.....	5,003 31	
" stamps, stationery, miscellaneous printing.....	491 89	
" equipment and supplies.....	963 19	
" apparatus, re-agents and implements.....	929 81	
" traveling.....	258 90	
" field experiments.....	228 13	
" repairs and erection Experiment Station buildings..	3,000 00	
" printing and paper for annual report and reports of progress.....	1,030 00	
" live stock.....	500 00	
" telephone service.....	177 58	
" library.....	400 00	
" equipments for dairy.....	600 00	
" mileage and <i>per diem</i> Board of Control meetings....	565 80	
		\$15,000 00

The undersigned, duly appointed Auditor for the State Board of Control, hereby certifies that the above items of expenditure, made by the North Carolina Agricultural Experiment Station for the fiscal year ending June 30th, 1888, are made up from the books of the Auditor of the Board and the Treasurer of the State of North Carolina (Treasurer *ex officio* of the North Carolina Agricultural Experiment Station), and that the receipts for the year named were \$15,000 and the disbursements \$15,000, for all which proper vouchers are on file in the office of the Treasurer above named.

(Signed) T. K. BRUNER, Auditor.

I hereby certify that the foregoing statements, made up from vouchers on file in this office, to which this is attached, are true and in accordance with the records of this office.

(Signed) DONALD W. BAIN,

Treasurer *ex officio* of the N. C. Agricultural Experiment Station.

I hereby certify that the two signatures above are those of the Auditor and Treasurer of the North Carolina Agricultural Experiment Station.

(Signed) H. B. BATTLE,

[SEAL.]

Director N. C. Agricultural Experiment Station.

The above is the seal of the North Carolina Experiment Station.

(Signed) ROBT. T. BURWELL,

Secretary N. C. Agricultural Experiment Station.

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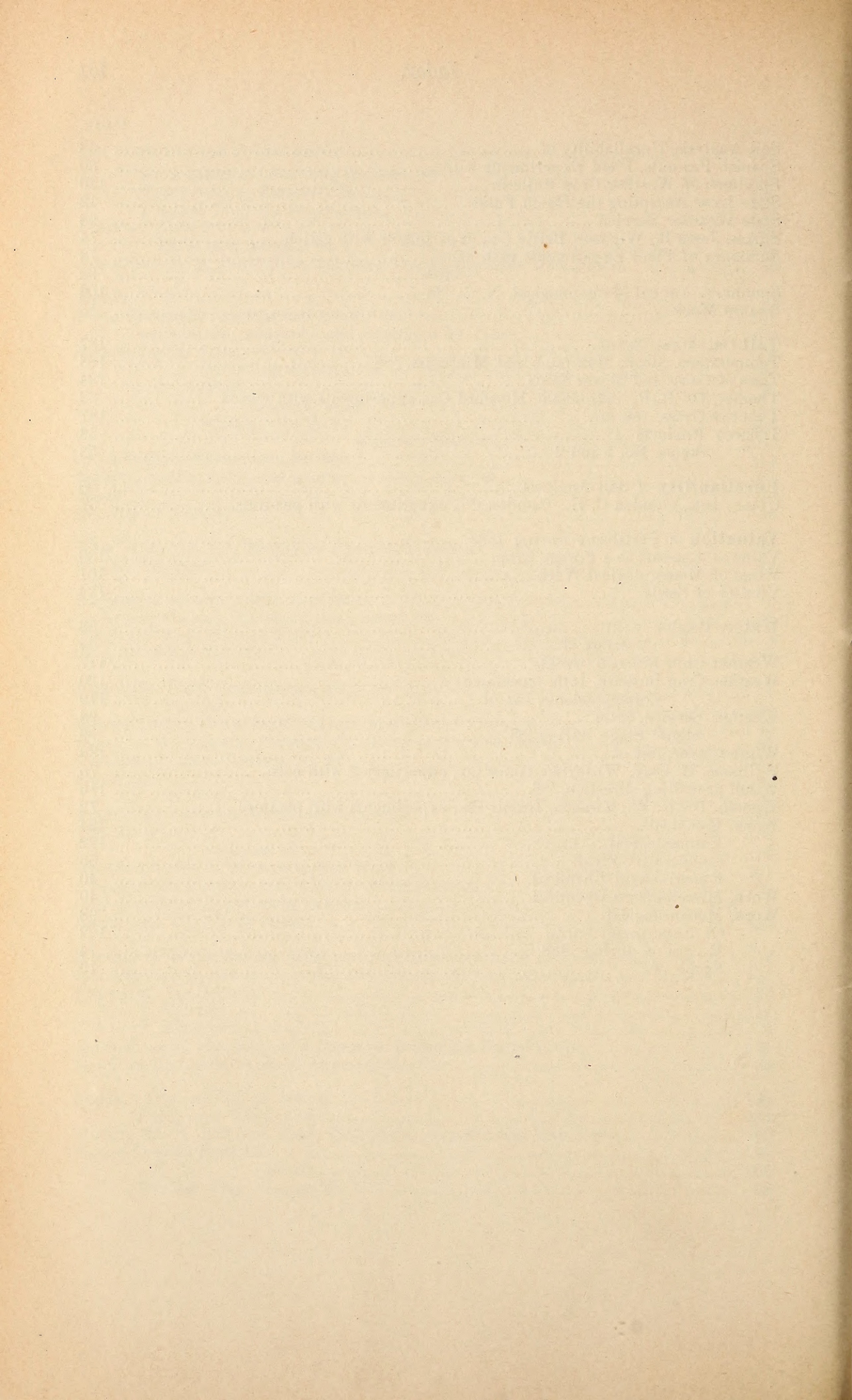
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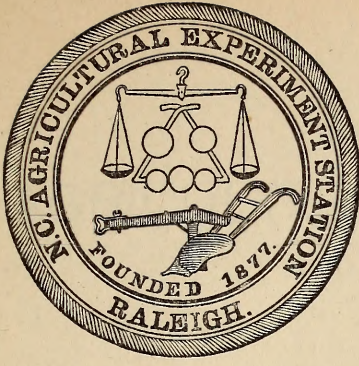
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Annual Report for 1889

OF THE

North Carolina

Agricultural Experiment Station,

To the Governor.

OFFICE OF
THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION,
RALEIGH, N. C., February 1st, 1890.

To His Excellency DANIEL G. FOWLE,
Governor of North Carolina:

SIR:—I have the honor to submit herewith a report of the operations of the N. C. Agricultural Experiment Station for the year ending December 31st, 1889.

This report is made in accordance with the following portion of section 3 of the Hatch Act of the Congress of the United States for the maintenance of Agricultural Experiment Stations in the various States:

“It shall be the duty of each of the said stations annually, on or before the first day of February, to make to the Governor of the State or Territory in which it is located, a full and detailed report of its operations, including a statement of receipts and expenditures.”

Trusting that this report will prove satisfactory to your Excellency,
I am, very respectfully yours,

H. B. BATTLE,
Director.

NORTH CAROLINA
AGRICULTURAL EXPERIMENT STATION
AND STATE WEATHER SERVICE,

UNDER THE CONTROL OF THE
STATE BOARD OF AGRICULTURE.

COL. W. F. GREEN, CHAIRMAN.

W. R. WILLIAMS, ESQ.....	Master State Grange Patrons of Husbandry.
COL. R. W. WHARTON	First Congressional District.
DR. W. R. CAPEHART.....	Second Congressional District.
W. E. STEVENS, ESQ.....	Third Congressional District.
J. S. MURROW, ESQ.....	Fifth Congressional District.
J. F. PAYNE, ESQ.....	Sixth Congressional District.
HON. A. LEAZAR.....	Seventh Congressional District.
BURWELL BLANTON, ESQ.....	Eighth Congressional District.
DR. C. D. SMITH.....	Ninth Congressional District.

TRANSFERRED DECEMBER, 1889 (BY LEGISLATIVE ENACTMENT OF 1887), TO THE
CONTROL OF THE

BOARD OF TRUSTEES, A. & M. COLLEGE,



COMPOSED OF THE STATE BOARD OF AGRICULTURE WITH

W. S. PRIMROSE, ESQ., <i>President</i>	Raleigh.
N. B. BROUGHTON, ESQ.....	Raleigh.
H. E. FRIES, ESQ.....	Salem.
COL. ELIAS CARR.....	Old Sparta.
CAPT. S. B. ALEXANDER.....	Charlotte.

RALEIGH, N. C.

NORTH CAROLINA

Agricultural Experiment and Fertilizer Control Station,

RALEIGH, N. C.

OFFICERS:

H. B. BATTLE, PH. D., Director and State Chemist.

J. R. CHAMBERLAIN, B. S.	Agriculturist.
W. F. MASSEY, C. E. (elected December, 1889)	Horticulturist.
F. B. DANCY, A. B. (resigned September, 1889).....	Assistant Chemist.
B. W. KILGORE, B. S.	Assistant Chemist.
F. B. CARPENTER, B. S.	Assistant Chemist.
B. THORP, B. S. (died July, 1889)	Assistant Chemist.
J. R. HARRIS	Assistant Chemist.
GERALD MCCARTHY, B. Sc	Botanist.
H. MCP. BALDWIN (U. S. Signal Corps), before July.....	Meteorologist.
C. F. VON HERRMANN (U. S. Signal Corps), after July.....	Meteorologist.
R. T. BURWELL, PH. B. (resigned September, 1889).....	Secretary.
H. L. HARRIS, B. S.	Secretary.

OFFICES AND LABORATORIES, CORNER OF EDENTON AND HALIFAX STREETS,
RALEIGH; FARM, PLANT HOUSE, EXPERIMENTAL BARN AND
DAIRY, 1½ MILES WEST ON THE HILLSBORO ROAD.

The Experiment Station, by legislative enactment of 1887, receives the benefit of all funds derived from the U. S. Hatch Act.

VISITORS CORDIALLY INVITED AND ALWAYS WELCOMED.

ANNUAL REPORT
OF THE
NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
TO THE GOVERNOR.

FOR THE YEAR 1889.

The scope of the work of the N. C. Agricultural Experiment Station has been formulated to be included under the following heads:

- I. *Chemical and Microscopical Work*, including
 1. The analysis of all fertilizers legally on sale in the State.
 2. The analysis of agricultural chemicals, of composts, and home-made fertilizers, and all materials from which they can be made.
 3. The analysis of soils, marls and mucks.
 4. The analysis of feeding stuffs.
 5. The analysis of potable and mineral waters.
 6. The examination of seeds with reference to their purity, and capacity to germinate.
 7. The examination of grasses and weeds.
 8. The study of insects injurious to vegetation.
 9. The analysis of milk, butter and other dairy products.
 10. Such other chemical and microscopical investigation as is demanded in the experimental work of the Station.
- II. *Experimental Work in the Field, Stable and Laboratory*, to include
 1. The effect of different fertilizers on various soils of the State.
 2. The study of improved methods for cultivation of the staple crops.
 3. The study of the best treatment for worn-out lands.
 4. The study of the best system for the rotation of crops.
 5. Chemical investigations, with practical experiments with cattle, on the value of the various forage crops.
 6. Investigations on the growth of new crops for this climate, in comparison with those we now have.
 7. The construction of the silo, and value of ensilage.
 8. The study of the growth of cattle using the different feeding stuffs.
 9. Investigations in the production of milk and butter under different conditions, and with various implements.
 10. Digestion experiments with stock, to ascertain the value of various food stuffs.

11. Experiments with the various feeding rations to ascertain how far the feeding standards can be relied on.

12. Such other work from time to time as may be deemed advisable for the interests of the agriculture of the State.

III. The Collection and Distribution of Meteorological Data, such as will directly aid the various agricultural industries of the State. The work is expected to be of benefit in

1. A foreknowledge of the coming of cold waves, protecting fruit, tobacco and trucking interests.

2. A foreknowledge of the coming of frosts, to benefit the same industries.

3. The distribution of daily telegrams of weather indications transmitted to various portions of the State.

4. The collection of various meteorological data, by obtaining a more perfect idea of the various climatic changes to extend to other localities the crops found useful in portions of this and other States.

5. The collection and distribution of reports showing the effect of the weather on the crops during successive periods of their growth.

IV. A Bureau of Information for all subjects connected with the agricultural industries of the State. Information of this character is always given as promptly and carefully as possible.

Samples, when sent by citizens of the State for chemical examination, will be analyzed free of charge—

1. If they are taken strictly according to our printed forms, and are fully described.

2. If they are of sufficient public interest, and the experimental work will not be unduly retarded thereby.

With this work in view, the result of the labors of the Station for 1889, has been classified in distinct divisions, as follows:

1. Chemical Division. 2. Agricultural Division. 3. Division of Co-operative Field Experiments. 4. Botanical Division. 5. Horticultural Division. 6. Meteorological Division. 7. Entomological Division. 8. Division of Publications. 9. Bureau of Information.

The work for the year has been greatly retarded by the many changes in the corps of workers at the Station. There have been two changes in the Chemical Division, one brought about by the resignation of the first assistant, Mr. F. B. Dancy; the other by the sad death of the third assistant, Mr. B. Thorp. The place of the former has been filled by the election of Mr. B. W. Kilgore, of the Mississippi Experiment Station. In the Meteorological Division (State Weather Service), Mr. C. F. von Herrmann has been detailed by the U. S. Signal Corps to act as assistant in place of Mr. H. McP. Baldwin. Mr. H. L. Harris takes the place of Mr. R. T. Burwell as Secretary. In the Agricultural Division, Mr. J. R. Chamberlain, Agriculturist, has been elected Professor of Agriculture in the Agricultural College. Pending the election of a suitable person to take his place as Agriculturist, he has been acting as such. This pro-

visional arrangement had not been changed up to the close of the calendar year of 1889.

The disarrangement of the force has quite seriously retarded the progress of the work of the Experiment Station. It has rendered it impossible to finish certain lines of investigation which should have been included in the publications of the year.

On December 8th, the Station was formally connected with the Agricultural College, and becomes a department of the College. This was in accordance with section 6, chapter 410, State Laws of 1887, which is as follows: "The Agricultural Experiment and Fertilizer Control Station, already established under the management of the said Board of Agriculture, shall be connected with the said College," etc. According to the agreement made between the Board of Agriculture and the Board of Trustees at the time of the transfer, the Station will still retain its distinctive existence. In becoming a department of the College, both Station and College will be mutually able to receive and give aid in the conduct of the work both of instruction and experimentation. It is believed that by this arrangement both the Station and College will accomplish more complete and thorough work.

At this time the Division of Horticulture was added to the Experiment Station, and Prof. W. F. Massey was elected Horticulturist.

The affairs of the Agricultural Experiment Station are now managed by the Board of Trustees of the College, composed of five members appointed by the Governor, together with the Board of Agriculture. The latter still has charge of affairs connected with the Fertilizer Control, inspection, sampling and analyses, as heretofore. It is proper to state, that for the work done for the Fertilizer Control by the Experiment Station, the Board of Agriculture appropriates to the latter a sufficient sum to reimburse the Station for the time and materials used. This appropriation also covers the cost of miscellaneous analytical work which may be done for the citizens of the State which does not properly come within the province of the Hatch Act.

A Station Council has been established to have in charge matters directly appertaining to the Station. This Council is composed of the President of the College, three members of the Board of Trustees, and the Director of the Station.

The record of work for 1889 is classified under the different divisions already enumerated, as follows:

I. CHEMICAL DIVISION.

a. Fertilizer Control. The operations of the Control have gone on as usual. By increasing the number of inspectors to three, the samples were procured at a much earlier date than ever before. Analyses were accordingly printed and sent out very early; the first

publication being on February 12th. This contained analyses of all of the licensed brands furnished up to that date. The second and third publications were on February 26th and March 26th, respectively. When it is considered that these samples are taken from the goods after they are received in the State, and the analyses must be made from these samples, it is easy to see how difficult it is to publish the analyses so that they can be used by the farmers before buying. It is believed, however, that the analyses for 1889 were, in most cases, published in ample time for this purpose.

One hundred and ninety-seven samples of commercial fertilizers were taken for the Fertilizer Control, and thirty samples of miscellaneous fertilizers were analyzed for farmers.

b. Experimental Chemical Work. Numerous samples of forage plants were analyzed to determine their food value. Among these were Dhoura corn, pearl millet, millo maize, early amber sorghum, Kaffir corn, German millet, Hungarian millet, etc. These were grown on the experiment farm, and the yield per acre for each is known. Chemical investigation has also been carried on relative to the food value of Kaffir corn-meal. Analyses have been made to ascertain the variability of composition of tobacco stems from various States.

The investigation which has already been commenced in relation to the chemical history of the cotton plant, has been, unfortunately, delayed, and is barely ready at this time for publication. A companion work has been outlined, and is now well under way, on the chemical history of the tobacco plant. This work will include the chemical examination of different portions of the plant from the seed-bed to the cured leaf.

c. Miscellaneous Chemical Work. Here is included the analyses of samples sent to the Station by farmers and others. This work is done without charge, provided the samples are of sufficient public importance to justify the work. Work of this character will be made public whenever it is thought best. Among these samples are embraced cotton seed products, marls and phosphates, tobacco products, mineral and health waters; soils, and miscellaneous work of a like character. Two hundred and forty-three samples were thus examined during the year.

II. AGRICULTURAL DIVISION.

Under this head is embraced the operations of the experiment farm. Experiments were conducted to ascertain the result of green manuring with cow-pea vines, and the effect of the same on the growth of wheat. Comparisons were also made with various application of fertilizing ingredients with this system of green manuring; the value of the ingredients, phosphoric acid, ammonia and potash, as fertilizing applications for cotton; plot experiments showing the

effect on the growth of cotton of various applications of lime in different forms, as unburnt lime, as burnt lime, as phosphatic lime, as carbonate and phosphate of lime combined with ammonia and potash materials,—all compared with the ordinary ammoniated fertilizer and with acid phosphate.

The purpose of this experiment was to test the value of a new fertilizer containing the ordinary ammonia and potash materials of commercial fertilizers mixed with insoluble phosphate and carbonate of lime. This fertilizer was made from the crude phosphate rock, mined and ground in the State, mixed with ammonia and potash ingredients. According to laboratory standards, these latter ingredients were available, but the phosphate of lime, being the insoluble tricalcic form, could not be so classed. The company placing this fertilizer on the market claimed that the presence of carbonate of lime mixed with the phosphate rendered the latter available to the plant in the field. The Station was constantly asked as to the value of such a combination as a regular fertilizing application. Beyond the fact that it could be stated that the phosphate was not available by laboratory methods, nothing definitely could be said in reference to field results, as no tests had been made by the Station to decide this point.

To ascertain its action, extensive tests were planned to compare it with unburnt lime, burnt lime, with the phosphate and carbonate of lime, unmixed with other ingredients, with acid phosphate, and with the regular ammoniated superphosphate with potash. The applications were all on a basis of equal cost, taking the money value of the regular application of an ammoniated fertilizer as the standard. The question sought to be answered, was whether it was desirable to purchase with the same amount of money, the usual commercial fertilizer or acid phosphate, or this new undissolved phosphate with ammonia and potash, or the corresponding value in either of the various forms of lime application. The question specifically asked was what the farmer would ask were he to be approached with the request that he purchase this new application.

The crop experimented with was cotton, on plots somewhat less than one-tenth acre each; all applications were in duplicate, to be compared with five unfertilized plots in various portions of the experimental field. The plan of the experiment included similar applications on the same plots, extending over several successive years, in order that it might be seen whether the lime applications were not more beneficial after the first year.

The plot chosen for the work was considered one of the best on the farm. Great care was exercised in every detail from beginning to end of the year's work. Yet, the result of the year's work was so disappointing and misleading that it is considered unwise to chronicle it at all. Although it was considered the best soil at the disposal of the Station for the work, yet the results proved so conclusively

that the soil was so far from being uniform that to print the results would be erroneous and misleading. Duplicate plots varied materially more than that due to the several applications. One part of the field, though seemingly nothing to indicate it, was discovered to be materially more fertile than another part and entirely irrespective of any application.

The result of this work, together with others of similar nature, which need not be mentioned here, point to the fact of the apparent futility of general field-work of a comparative nature at the experiment farm with its soil so ill adapted to it. The conclusion was reached that work of this character must be conducted in other localities. Without specifying, at this time, what definite changes will be made on account of this decision, it may be as well to state that more attention in the future will be paid to a few distinct locations throughout the State where co-operative work will be carried on in connection with the central work in Raleigh. By fostering the efforts in these localities, it is expected that the results of the experiments there will more nearly represent the various local conditions than is possible from what may be done at this point, even if the soil here was entirely applicable to the work. In addition, the work of the Station and of the district stations will thus be brought more closely to the farmers, the value of which cannot well be over-estimated.

The Experiment Station farm will in the future be utilized for various horticultural work commenced in the field and plant-house, and for detailed work in the dairy, for the feeding of cattle, the growth of various feed-stuffs, forage plants and grasses, in connection therewith.

Cattle-feeding experiments have been conducted to ascertain the value of cotton-seed hulls and meal alone, for the purpose of fattening cattle; the value of the same food as compared with ensilage for fattening sheep.

Details of these experiments will be given in the report of the Agriculturist.

III. DIVISION OF CO-OPERATIVE FIELD EXPERIMENTS.

It is impossible to generalize from the result of one experiment, or a series of experiments, made in any one locality. Recognizing this, it was thought eminently proper to conduct similar experiments in various portions of the State. North Carolina embraces such a variety of soils, climates and areas that such work is especially needed here. Accordingly, the co-operative field experiments commenced in 1888 were continued for 1889. The territory embraced for the latter year is larger than heretofore, and covers the central and western sections, as well as the eastern section of the State.

The list of experimenters for the season of 1889 includes the following names:

Eastern District.—W. L. Barlow, Tarboro, Edgecombe County; J. W. Bryan, Goldsboro, Wayne County; Dr. D. Cox, Hertford, Perquimans County; F. R. Johnston, Plymouth, Washington County; T. L. Jones, Columbia, Tyrrell County; E. F. Lamb, Elizabeth City, Pasquotank County; E. Mears, Clarkton, Bladen County; J. B. Oliver, Mount Olive, Wayne County; W. H. Shields, Scotland Neck, Halifax County; O. W. Sutton, Mount Olive, Wayne County; Dr. R. P. Thomas, Bethlehem, Hertford County; H. Clay Williams, Willeyton, Gates County; J. G. Williams, Edenton, Chowan County; Dr. R. W. Wooten, Kinston, Lenoir County.

Central District.—C. N. Allen, Auburn, Wake County; H. B. Hunter, Sr., Ridgeway, Warren County; T. J. King, Louisburg Franklin County; T. B. Lindsay, Douglas, Rockingham County; W. B. Little, Deep Creek, Anson County; R. D. Lunceford, Smithfield, Johnston County; Prof. A. McIver, Pittsboro, Chatham County; J. C. Williams, Winslow, Harnett County.

Western District.—W. E. Ardrey, Pineville, Mecklenburg County; J. C. Cooper, Dobson, Surry County; Lee Crawford, Franklin, Macon County; H. C. Dunn, Clear Creek, Cabarrus County; R. G. Hamilton, Mill Spring, Polk County.

The plot experiments embraced the application of different fertilizing ingredients—cotton-seed meal, acid phosphate and kainit—furnishing ammonia, phosphoric acid and potash respectively. These materials were used as being the most available for ordinary use. While, for exact experimentation, pure chemicals should have been taken; yet, under the circumstances, it was considered that the materials used were sufficient for the ends of the experiments. The crops planted for this field-work were cotton, corn and peanuts. The field plots were $\frac{1}{20}$ acre in extent. Various forage plants which might prove useful in the different localities were tried, as well as some other plants which might become serviceable adjuncts to the ordinary staple crops. One-fiftieth acre plots were used, and the yield as closely as possible was recorded. The list was as follows:

1. Kaffir corn; 2. Egyptian rice corn; 3. Brazilian flour corn;
4. Improved evergreen broom corn; 5. Improved dwarf broom corn;
6. Early amber sugar cane; 7. Early orange sugar cane; 8. Early rural branching sorghum; 9. Prolific tree bean; 10. Soja bean;
11. Pearl millet; 12. Canadian field peas—white; 13. Canadian field peas—blue; 14. Flax; 15. Sunflower; 16. Silver ramie.

The results attendant upon these co-operative field tests were, in the main, very satisfactory. Much interest was manifested in the work in nearly every locality, and from letters received it is known that material good was accomplished.

IV. BOTANICAL DIVISION.

The botanical work for 1889 included a continuation of the work towards arriving at a specific standard of quality for field and garden seed. For this purpose several hundred tests of varieties of seed were made. Samples were secured directly from the growers, as well as purchased from retail dealers. It is well to note, in passing, that the quality of the two varied widely. It is proposed to give the local dealer the benefit of the doubt, and say that where low vitality of the seed was noticed, it was due to their being kept on hand for too long a time before being sold. In other words, the retail dealers were not particular in every case to offer strictly fresh seed. It may be that they did not know that seeds deteriorated on being kept.

Many growers sell strictly first-class seed, both as to purity and vitality. Others do not. To the first should be bestowed praise; the second, condemnation. A fair conservative standard for seed, which could be used both by seller and buyer, would be a protection both to the buyers and the honest sellers who deal in strictly first-class seed, and who wish to sell no other. As to the other class of dealers and growers who do not sell fresh and pure seed, either through ignorance or dishonesty, the seed standard would compel them to improve the quality of their merchandise. It is useless to deny that there are many of this class of dealers who are constantly disposing of worthless seeds under the guise of fair-trading—who sell, in their seed, a large quantity of weed seeds which are destructive to crops and very difficult to eradicate. It is this class that a seed standard would control with great benefit to the buyers, as well as to the honest seller of good seed.

It is not expected that an experiment station will endeavor to regulate the sale of seed, or to inaugurate laws for the control of the trade. This belongs to the law-makers. It is not the legitimate work of agricultural experimentation. The work which has been begun at this Station, can be mentioned under two heads: First, to fix a conservative standard for comparison, by means of a careful examination of the seed sold by reputable dealers and growers, both as to purity and vitality; in this way, to arrive at a definite grade for the various seeds which should be reached before these seeds could be classed as good. Second, to teach the buyers of seeds that the cheapest seeds are very far from being the seed which ought to be purchased and used; that while they are the cheapest in one sense, they are the dearest in another; that these seeds have, for the most part, low vitality, are impure and contain weed seeds which should not find a foothold in any cultivated field. It is expected that a more thorough knowledge of this important matter cannot but result in the accomplishment of material good.

Further work has been carried on in the investigation of the

growth of lucerne in the various portions of the State, to compare the relative value of spring and fall sowing. Many plants have been identified and their value discussed. Miscellaneous samples of seed from farmers and others have been tested, and their purity and vitality specified.

V. HORTICULTURAL DIVISION.

This division of the Station was added in December, and Prof. W. F. Massey elected Horticulturist. But little can be mentioned here beyond a mere outline of the proposed work. Details and results will be left for a later time.

The vineyard and fruit interests will be carefully investigated, and the best varieties, methods of cultivation most suitable to the State, will be studied and recommended. The varieties of vegetables most suitable for early marketing will be studied, and the best methods for shipment determined. Other plants which promise well for the State will be carefully examined.

It is confidently expected that the work of this division will aid in the material advancement of the trucking interest, the fruit and vineyard interests—all of which have grown to be extensive and valuable industries in our State.

VI. METEOROLOGICAL DIVISION.

Under this head is included the operations of the State Weather Service. A member of the U. S. Signal Service is detailed here as Meteorologist and assistant in the Weather Service, and acts without pay from the Station. The Station is at no expense therefore for the continuation of this work beyond that of merely printing the results. There has been a growing tendency for some time past to transfer the U. S. Signal Service to the U. S. Department of Agriculture, in order that it may become more directly connected with the agricultural interests of the country. The present U. S. Congress is appreciating this demand, and has already formulated a bill for the transferral of the Signal Service, which will, without doubt, become a law. This is mentioned to show that the connection of the Weather Service here with the Experiment Station, and with the agricultural interests in it involved, has not been ill-timed.

The Station has aimed to benefit these interests during 1889, as heretofore, by the distribution of telegrams showing the probable state of the weather for the succeeding twenty-four hours. By foretelling the coming of frosts and cold waves, the various farming interests, fruit and trucking industries will be directly benefitted; by the collection of meteorological data through the medium of various co-operating observers, both voluntary and U. S. Signal Corps, scattered throughout the State, a more definite idea of the

various climatic changes may be obtained. In this way the growth of new plants and crops may be found possible where, through lack of full meteorological data, such may not be known at present.

The Weather Crop Bulletin, which attracted so much attention in 1888, has been issued weekly during the growing season. The number of reporters were materially increased over that of the year previous; the value of the bulletins were thus largely enhanced.

For detailed points in connection with the operations of the weather service, reference must be made to the report for 1889, bound in as an appendix herewith.

VII. ENTOMOLOGICAL DIVISION.

While at present there is no Entomologist on the staff of the Station, yet, for convenience of work this division is kept distinct. It is the intention of the Station at some future time to add a specialist for this division; in the meantime, that portion of the work of the Station falling in the entomological line is assumed by others of the staff. During the ravages of the caterpillar, which was so destructive to cotton in some portions of the State during the summer, a special bulletin was prepared and mailed promptly to all the newspapers of the State. In it was given the life history of the cotton worm, and methods to be adopted for its extermination. The various papers very kindly printed this bulletin in full, and in this way were the people reached with much more facility and dispatch than through the regular issue of the bulletin.

From time to time, as occasion demands, are insects identified and reported. Special bulletins will also be prepared whenever there is need of the same.

VIII. DIVISION OF PUBLICATIONS.

The publications of the Station are classified under different heads as follows:

a. Regular Issues.—These are sent to every name on the Station's mailing list, embracing 11,444 farmers and others in the State; also newspaper exchanges, scientific exchanges, scientists, experiment station officers, and others throughout the country. In all, these issues are sent to somewhat over thirteen thousand names. The bulletins are numbered consecutively. The matters contained therein will be of such a nature as to be easily comprehended by the unscientific reader, and will contain results of experiments as well as matter not original when bearing upon the work.

The following is a list of the regular issue of the Bulletin for 1889:

Bulletin No. 62—February 26.

Article XII. Fertilizer Analyses and the Fertilizer Control, Season of 1889.

Bulletin No. 63—June.

Article XIII. 1. Tests of Seeds with Special Reference to the Vitality of Old Seed.

2. Rust on Wheat and Cotton.

Article XIV. Laboratory Notes.

1. Does Stable Manure in Drying lose any of its Ammonia?

2. Additional Analyses of Commercial Fertilizers.

3. Pamunky Marl Phosphate.

Bulletin No. 64—July.

Article I. Practical Stock Feeding on Scientific Principles, Together with its Relations to Chemistry.

Bulletin No. 65—August—September.

Article II. Co-operative Field Tests During 1888.

Bulletin No. 66—September 15.

Article III. Stock Feeding as Practiced in North Carolina.

Article IV. Indian Corn.

Bulletin No. 67—October 15.

Article V. Seed Tests.

Bulletin No. 68—November 1.

Article VI. Farm and Dairy Buildings.

b. Special Issues.—Include publications not mailed to the general list, but are sent to those specially interested in their contents. These Bulletins are numbered with the numbers of the regular issues, with additions of letters, generally, to prevent confusion. Following is a list of these Bulletins with circulation of each:

Bulletin No. 61½—February 12. Fertilizer Analyses, Partial List. Seed Examination for Planters. Sent only within the State,

Bulletin No. 62½—March 26. Fertilizer Analyses and the Fertilizer Control. Sent only within the State.

Bulletin No. 64a—August. The Cotton Worm; the Best Measures to Prevent its Ravages. Sent to State papers for insertion in their columns.

Bulletin No. 65a—November. Special edition, embracing wall charts, showing some of the benefits of the Station to the farmers of the State. These were sent to nearly two thousand Secretaries of Alliances for posting on the walls of Lodges, also to every newspaper.

Bulletin No. 67a—October. Technical Bulletin No. 1, Seed Tests. Sent to scientific exchanges and special list, embracing newspapers, Stations and others. This Bulletin will be bound in with this report as an appendix.

Bulletin No. 68a—November 15. Meteorological Division, No. 1. Meteorological Summary for North Carolina for October. Sent to State weather services, meteorological exchanges, and State papers.

Bulletin No. 68b—December. Meteorological Division, No. 2. Meteorological Summary for North Carolina for November.

Weekly Weather Crop Bulletin. Issued only during growing season. Sent to newspapers, special reporters, and meteorological exchanges.

c. Annual Reports.—Editions of five thousand copies are mailed to a selected list of names, exchanges, Stations, newspapers, Alliances, for libraries, etc.

IX. BUREAU OF INFORMATION.

It is the endeavor of all connected with the Station to make this division as accurate and valuable to the farmers in the State as possible. All questions are very carefully considered in the appropriate divisions, and are answered as promptly as possible.

THE NORTH CAROLINA AGRICULTURAL EXPERIMENT STATION
IN ACCOUNT WITH
THE UNITED STATES APPROPRIATION.

1889.		Dr.
To receipts from the Treasurer of the United States, as per appropriation for the year ending June 30th, 1889, under act of Congress approved March 2d, 1887.....		\$15,000 00
		Cr.
June 30.	By salaries	\$7,244 17
"	wages of servants and farm labor.....	1,293 71
"	telephone service	120 00
"	apparatus, re-agents and implements.....	1,263 96
"	stamps, stationery and miscellaneous printing.....	546 22
"	express freights and incidentals	572 35
"	periodicals and books of reference.....	136 43
"	annual reports and reports of progress.....	1,137 64
"	farm supplies.....	921 44
"	fertilizers, seed, plants, etc	396 26
"	repairs and fixtures	444 95
"	gas, fuel and stoves	464 35
"	equipments and supplies	114 75
"	paper for reports of progress	297 70
"	travelling	46 07
		\$15,000 00

The undersigned, duly appointed Auditor for the State Board of Control, hereby certifies that the above items of expenditure, made by the North Carolina Agricultural Experiment Station for the fiscal year ending June 30th, 1889, are made up from the books of the Auditor of the Board and the Treasurer of the State of North Carolina (Treasurer *ex officio* of the North Carolina Agricultural Experiment Station), and that the receipts for the year named were \$15,000 and the disbursements \$15,000, for all which proper vouchers are on file in the office of the Treasurer above named

(Signed) T. K. BRUNER, Auditor.

I hereby certify that the foregoing statements, made up from vouchers on file in this office, to which this is attached, is true and in accordance with the records of this office.

(Signed) DONALD W. BAIN,
Treasurer ex officio of the N. C. Experiment Station.

REPORT OF THE CHEMICAL DIVISION.

Through the Chemical Division, the Station is enabled to carry out one of the objects designed for it by the statutes of 1877. This is to protect, by a fertilizer control, the farmers of the State from fraudulent fertilizers, and by a judicious control of the trade in general, through careful inspection and analysis, to see that the guaranteed grade of the fertilizers is maintained.

THE FERTILIZER CONTROL.

SEASON OF 1889.

The great difficulty this year has been, as heretofore, in securing samples for analysis. This is due not to any fault of the inspectors in failure to secure the samples, but to the lateness of time at which fertilizers are shipped into the State and offered for sale. The samples are all drawn from goods after they leave the manufacturers' hands, and consequently not until they are in the hands of local agents can samples be taken. The wisdom of this plan is manifest, since in this way is all possibility of securing an erroneous sample avoided. While it may throw the analyses somewhat late, yet even this is preferable to accepting samples sent by manufacturers to represent goods designed to reach the farmers.

DIGEST OF FERTILIZER LAWS IN FORCE IN NORTH CAROLINA.

In order to give a short and more concise statement of all laws now in operation in regard to the fertilizer inspection and control, the following carefully prepared digest of existing laws is inserted, as a guide to the fertilizer trade and for the information of the farmers. The full text of the fertilizer laws can be supplied upon application:

No manipulated guanos, superphosphate or other commercial fertilizers, shall be sold or offered for sale until a license shall be issued by the State Treasurer.

This privilege tax of \$500 per annum is required for each separate brand or quality. The Department of Agriculture has power at all times to have samples collected of any fertilizer on sale, which must be taken from at least ten per cent. of the lot selected. These samples are taken from the goods in the hands of dealers after they are shipped from the manufactories, and accordingly represent the true grade of fertilizers offered for sale.

Every package of fertilizer offered for sale must have thereon a plainly printed label, a copy of which must be filed with the Commissioner of Agriculture, together with a true sample of the fertilizer which it is proposed to sell, at or before the shipment of such fertilizer into the State, and which label must be uniformly used and not changed during the year. This label must set forth the name, location and trade-mark of the manufacturer, also the chemical composi-

tion of contents, and percentage of the ordinary ingredients, together with date of analyzation, and that the tax has been paid.

By a recent ruling the variation in claims, which has been allowed for a number of years, is now no longer accepted. The bags must be branded with the exact chemical composition of the contents. Licenses issued after this ruling will all conform to this plan.

Any fertilizer that is offered for sale without being licensed, or that is spurious and does not contain ingredients as represented by the label, is seized, and, after being established on trial, its value is recovered by the Board of Agriculture.

Any person who offers for sale a fertilizer without having attached thereto labels as provided by law is liable to a fine of \$10 for each separate package, one-half, less the cost, going to the party suing, and the remainder to the Department; and if such fertilizer is condemned the Department makes analysis of the same and has printed labels giving the true chemical ingredients of the same put on each package, and fixes the commercial value at which it may be sold.

The Department of Agriculture can require agents of railroad and steamboat companies to furnish monthly statements of the quantity of fertilizers transported by them.

The Director of the Experiment Station analyzes all fertilizers required, which are published when deemed needful.

In order to further define the term "commercial fertilizer," it was resolved by the Board of Agriculture, October 15th, 1879:

"That the following articles shall be admitted free of tax, with such additions or changes as may afterwards be made by the Executive Committee, upon consultation with the chemist, viz.: ground bone, bone ash, ground bone-black, ground phosphate rock, or other mineral phosphate, nitrogenous organic matter commercially free from phosphoric acid and potash, nitrate of soda, nitrate of potash (saltpetre), sulphate of ammonia, muriate of ammonia, kainite, sulphate of magnesia, sulphate of potash, sulphate of soda, muriate of potash, lime, plaster, ground cracklings, ground tankage, salt, and oil of vitriol."

Upon the following articles the license tax will be exacted:

"Any of the above articles, or others, sold for fertilizing materials *under any trade-mark or proprietary brand*; upon dissolved bone, dissolved bone-black, dissolved mineral phosphates (all acid phosphates or superphosphates), and upon any two or more of the articles mentioned in the first list, if combined, either chemically or mechanically."

ANALYSES OF FERTILIZER SAMPLES FROM FARMERS.

All official analyses are made from samples taken by the authorized inspectors. These only are published and are sufficient as final evidence if the guaranteed claim is not maintained.

In any special cases where there appears to be a reason for doubting that the lot be not up to the guaranteed claim, the Experiment Station will analyze a sample of the same, provided it is taken strictly according to the instructions which are given below. The sampling must be witnessed by two additional persons, who must attest the same by their signatures. The sample must also be sealed in their presence.

N. C. EXPERIMENT STATION.

DIRECTIONS FOR SAMPLING FERTILIZERS.

The Station makes analyses for farmers of North Carolina without charge; provided the samples are taken according to these directions and proper form is completely filled up and certified to.

Samples, when accepted, will be entered upon our register in the order of their coming, and analyzed in turn. The results of each analysis will be promptly communicated to the person sending the sample.

Fertilizers are sampled by the regular inspector for official analysis.

The valuation of a high priced fertilizer requires the amounts, or per cents. of its principal fertilizing elements, to be known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined directions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains nor loses moisture during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind or from keeping in a poorly closed vessel.

1. Provide a tea-cup, some large papers, and for the sample a glass fruit jar, or tin can or box, holding about one quart, that can be tightly closed—all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizers, and enter these actual weights in the "Form for Sending Fertilizer Samples."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if necessary, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly, but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, seal in the presence of witnesses, label plainly, and send, charges prepaid, to

THE N. C. AGRICULTURAL EXPERIMENT STATION,

Raleigh, N. C.

The following is a sample of the form which is supplied on application, in case it is desired to send a sample of commercial fertilizer to the Station. The fertilizer must be licensed for sale in the State. All of the form must be filled completely:

N. C. EXPERIMENT STATION.

FORM FOR SENDING FERTILIZER SAMPLES AND CHEMICALS.

This Form must be Filled up Completely or Sample may be Rejected.

NEVER SEND A SAMPLE GIVEN YOU BY A MANUFACTURER OR DEALER.

DATE OF TAKING SAMPLE.....189...

N. C. AGRICULTURAL EXPERIMENT STATION, RALEIGH, N. C.:

SIR: I send you to-day, marked....., contained in a....., a fair sample, drawn according to directions on opposite side of this sheet, of the following fertilizer:

Weight branded on each bag or package.....lbs.

Actual weight of one bag or package.....lbs.

Name of fertilizer.....

Manufactured by.....

At.....

Purchased of or received from.....

At.....

Selling price per ton, bag or barrel, \$.....

Give the amounts of the following ingredients as branded on the bags:

Available (or soluble and reverted) phosphoric acid..... per cent.

Nitrogen (or ammonia), if claimed..... “

Potash, if claimed..... “

My reasons for supposing this fertilizer is below its guarantee are:

.....

Name,.....

Post-office,.....

THIS CERTIFICATE MUST BE SIGNED BY TWO WITNESSES:

We hereby certify that we have witnessed the drawing of the above sample, that it is a fair one and taken according to the instructions on the opposite side of this sheet, that the above copy of names and figures is a correct one, and that it was sealed in our presence and delivered to the post-office or express company.

Name of Witness.....

Name of Witness.....

NO ANALYSES OF UNLICENSED BRANDS WHEN ORDERED BY FARMERS.

In the fertilizer control, the Station offers protection to farmers, in seeing that the claims of manufacturers for their goods are sustained. The manufacturers on their part pay the license tax for the privilege of selling their brands in the State. Official inspectors

take samples of the brands after they are out of the control of the manufacturers. The Experiment Station analyzes these samples to see that the guarantee is maintained. So much for the official control of licensed brands.

There is nothing in the present law to prevent any person, acting for himself alone, from ordering any unlicensed brand of fertilizer *for his own use*. He does it, however, at his own risk, for the Station can offer him no protection in the way of analyzing the fertilizer. There being no restriction as to a purchase of this kind, either on the part of the buyer or seller, we can offer no protection to the purchaser.

FERTILIZERS DURING 1889.

The number of brands licensed for sale during the year 1889, shows a small increase over the years previous.

In order to show the character of the trade for the year, and for comparison of several years past, the subjoined table is inserted, giving the number and description of the different brands on sale in the State. It will be noted, however, that as the licenses do not lapse with the calendar year, a single license can extend through portions of two years. The numbers, therefore, while showing the number of licenses in force, do not show the actual number of licenses issued during each year.

	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
"Acid phosphates," or simple superphosphate	8	10	11	7	9	11	10	9	12
Superphosphates with potash,	9	15	15	10	10	9	8	7	5
Ammoniat'd superphosphates	40	55	61	56	63	66	58	62	62
Natural guanos	1	3	2	3	2	3	1	1	1
Agricultural lime	1	1	2	1	1	1	--	--	--
Specialties	--	2	1	--	--	--	--	--	1
	<u>59</u>	<u>86</u>	<u>92</u>	<u>80</u>	<u>85</u>	<u>90</u>	<u>77</u>	<u>79</u>	<u>81</u>

The average composition of ammoniated superphosphates with potash show, with some slight fluctuations, an improvement over that of former years.

AMMONIATED SUPERPHOSPHATES, WITH POTASH.

	1880.	1882.	1883.	<i>Average in</i>		1886.	1887.	1888.	1889.
				1884.	1885.				
Available phosphoric acid....	7.40	8.91	8.59	8.15	9.13	8.69	8.54	9.11	8.74
Ammonia	2.70	2.60	2.33	2.67	2.65	2.53	2.43	2.61	2.57
Potash	1.30	1.82	2.18	2.13	2.34	2.30	2.08	2.33	2.23
Valuation on the 1889 basis.	\$21.10	23.50	22.56	23.04	24.60	23.53	22.71	24.42	23.65

It will be noticed that with some changes, the increase in available phosphoric acid has been decided, the ammonia has been remarkably close for all of the years, the potash from 1.30 in 1880 to 2.23 in 1889, or an increase of nearly one per cent. Using the seaboard valuation of 1889 for all the years, viz.: Available phosphoric acid, 7c. per lb., for ammonia, 17c. per lb.; for potash, 6c. per lb.; the valuation per ton has varied from \$21.10 to \$23.65.

As to the cost of these fertilizers to the farmers the change has been more decided. In 1877, when the Station was established, the average cash price of the ammoniated fertilizer was \$43.50 per ton. This same fertilizer in 1889 could be bought for \$27.50—a reduction in price of \$16.00 per ton. This means that our farmers in 1889 could buy for three million dollars what they paid over four million for in 1877. And not only this, but the average fertilizer is better than it was in 1880. It is not claimed that the Station was the sole cause of this reduction, but that by a judicious control of the trade in renewing confidence between the dealers and consumers, in the prevention of fraud, in producing healthy competition, it aided largely towards this end.

The cost of the different ingredients for 1889 was higher than for 1888. It is possible that this may have been the cause of the slight decrease in average composition. It is the law of trade that competition produces small profits. Competition, together with a higher price of ingredients, would tend all the more to lower the percentages of the average fertilizer. The increase in cost of ingredients to the manufacturers was fully 12 to 15 per cent. during this year. It is wonderful, under the circumstances, that the decrease in composition has been so slight.

An investigation of these licensed brands as to the States in which they were manufactured, will be interesting. On this basis the following table has been compiled:

WHERE THE FERTILIZERS ARE MANUFACTURED.

	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
Massachusetts.....	2	3	--	2	2	3	1	4	6	2
Connecticut.....	1	2	2	4	3	3	1	2	1	1
New York.....	3	6	5	3	2	4	3	1	1	2
New Jersey.....	3	3	1	1	1	2	3	2	4	4
Delaware.....	2	2	2	2	2	4	4	4	3	3
Maryland.....	21	25	45	42	30	31	35	29	25	28
Pennsylvania.....	--	--	1	1	--	--	1	--	1	--
Virginia.....	7	9	15	17	20	18	21	14	12	12
North Carolina.....	3	3	6	6	8	9	10	11	13	14
South Carolina.....	5	6	9	14	12	11	11	10	13	15
Totals.....	47	59	86	92	80	85	90	77	79	81

A casual glance at the above table will show how the number of fertilizer licenses accredited to the States of Virginia, North Carolina

and South Carolina, have increased, notably so in the case of North Carolina, where the increase has been over fourfold within eight years.

As illustrating this fact the following calculation is inserted, which shows the per cent. of the brands which were manufactured in the three States before mentioned for the different years:

THE NUMBER OF BRANDS MANUFACTURED IN THE THREE STATES, VIRGINIA, NORTH CAROLINA AND SOUTH CAROLINA, FOR THE YEARS 1880 TO 1889,
IN PER CENTS OF THE WHOLE NUMBER.

	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
Virginia	}	31.92	30.50	34.88	40.21	50.00	44.70	46.67	45.45	48.10
North Carolina..										
South Carolina..										
										50.62

In reference to North Carolina alone, the change is more decided:

THE NUMBER OF BRANDS MANUFACTURED IN NORTH CAROLINA FOR THE YEARS 1880 TO 1889, IN PER CENTS OF THE WHOLE NUMBER.

	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.	1889.
North Carolina..	6.38	5.08	6.97	6.52	10.00	10.47	11.11	14.30	16.46	17.28

“Here the increase is nearly threefold. What does this change foretell? Considering the number of brands as indicative of the amount sold, which can safely be said, since the conditions for the various years have remained unaltered, these figures prove almost conclusively that the home manufacturers are gradually driving the other more distant competitors from the field; that the distance from the source of supply of the various ingredients, and from the market where the fertilizers are sold, and the consequent high freights which these fertilizers must pay to reach a market, are proving each year a more effectual barrier, in a commercial point of view, to their entering the State. Taking our own State and the two adjoining, it is plainly seen that the three, while they controlled one-third of the trade eight years ago, now control one-half. North Carolina alone, eight years ago, controlled only one-sixteenth, now controls one-sixth. With this increase—and there is now no reason why it should not continue—it is not hazardous to assert that *in ten years, one-half of the commercial fertilizers sold in North Carolina will be made in North Carolina.* An additional reason for this assertion is, that the State, either alone or by calling on South Carolina, can furnish the raw ingredients, except potash, sufficient to make all of the fertilizers needed here. With our comparatively inexhaustible beds of phosphates, which will be surely worked in the future much more extensively than at present, it very probably will not be necessary to procure any of the raw materials from South Carolina.” The above, taken from the report for 1888, shows what was the apparent

tendency of the trade at that time. Experience of 1889 indicates that the above prediction is slowly becoming fulfilled.

FERTILIZER ANALYSES AND VALUATION DURING 1889.

In the following pages are inserted the analyses of official samples from the inspectors, completed for the season of 1889. The samples were all taken from goods received after the beginning of the year, and at least 10 per cent. of the bags or packages were sampled in each case. The inspectors are always especially cautioned not to sample goods which have been exposed in any way so that their quality may have been injured.

Last year (1888) was rated at the seaboard:

Available phosphoric acid	6 cents per pound.
Ammonia	15 cents per pound.
Potash	5 cents per pound.

This year (1889), on account of the increased cost, the ingredients are rated at the seaboard:

Available phosphoric acid	7 cents per pound.
Ammonia	17 cents per pound.
Potash	6 cents per pound.

These values are chosen, not to represent the exact cost of the ingredients at the seaboard, but as an approximation of the value of these ingredients after they are mixed, bagged, and ready for sale in manipulated goods. Approximately these values, then, when calculated in fertilizers, indicate the cost at which the fertilizers can be purchased at the ports in small lots, less than 5 tons, *for cash*. At interior points, freight to those points should be added. At best, however, these commercial values are approximate only. Their chief importance is to facilitate comparison between the various brands, though even here discretion must be used. A knowledge of what special ingredients, whether phosphoric acid, ammonia or potash, are needed for particular soils, should guide every one in their selections.

The standard methods of the association of official agricultural chemists are used for every determination in the analyses. The Station's Laboratory Register No. is given on the pages to the left, as well as the brand name, name of the manufacturer or general agent, and the locality where the sample was taken.

All the figures (except valuation) are given in parts per 100.

Water is the amount of moisture lost by continued heating of the fertilizers, exactly at the temperature of boiling water (212° F.) and no higher.

Insoluble phosphoric acid embraces that form of phosphoric acid which is insoluble in standard neutral solution of ammonium citrate (specific gravity 1.09) according to the methods referred to above.

Reverted phosphoric acid represents the phosphoric acid (other than the soluble in water) which will dissolve in this solution.

Soluble phosphoric acid is that form of phosphoric acid which will dissolve in pure water at ordinary temperature.

Total available phosphoric acid is the sum of the reverted and soluble phosphoric acid, since these forms are generally conceded to be readily *available* to the plants in the soil. The total available phosphoric acid must not be confounded with total phosphoric acid, which is the sum of the three forms given above—the insoluble, the reverted, and the soluble phosphoric acid. Oftentimes the phosphoric acid in either of these forms is given in the equivalent of “bone phosphate,” “phosphate of lime,” or “tricalcic phosphate”—and expresses the combination in which the acid occurs in the fertilizer. The factor for converting the phosphoric acid into the bone phosphate is 2.183.

Ammonia. The valuable element found in ammonia (N H_3), organic nitrogenous materials, and nitrates, is nitrogen (N). The quantity of this latter element is estimated, whether occurring in either of these forms, and calculated to ammonia.

Potash is given as actual potash (K_2O) and not in any of its combinations. This potash is readily dissolved by water.

Relative commercial value per ton. These valuations are intended to show at what prices approximately the fertilizers can be purchased *at the seaboard* for cash in small lots of 5 tons and under.

The following calculation will illustrate how the relative commercial values are obtained from the analyses:

8.40 per cent. available phosphoric acid=8.40 pounds per 100, at 7 cts. per pound	\$.58 80
2.35 per cent. ammonia=2.35 pounds per 100, at 17 cents per pound...	.39 95
1.87 per cent. potash=1.87 pounds per 100, at 6 cents per pound .....	.11 22
Value per 100 pounds	\$ 1.09 97
	20
Relative commercial value per ton (2,000 pounds)	\$ 21.99 40

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
5451	Acid Phosphate	Rasin Fertilizer Co., P. O. Box 715, Baltimore, Md.	Dunn	1
5348 } 5404 }	Acme Fertilizer	Acme Manufacturing Co., Wil- mington, N. C.	Wadesboro Wilmington	2
5417 } 5465 }	Ammoniat'd Dissolved Bone,	Jno. Merryman & Co., 24 2d St., Baltimore, Md.	Wilmington Laurinburg.	3
5371 } 5391 }	Ammoniat'd Dissolved Bone Phosphate,	H. S. Miller & Co., Newark, N. J.	Goldsboro Newbern	4
5625	Ammoniated Soluble Navassa Guano,	Navassa Guano Co., Wilming- ton, N. C.	Fair Bluff	5
5690	Anchor Brand for To- bacco,	Southern Fertilizing Co., 1321 Cary St., Richmond, Va.	Thomasville	6
5355	Ashepoo Acid Phos- phate,	Ashepoo Phosphate Co., Robert- son, Taylor & Co., Agents. Charleston, S. C.	Wadesboro - ...	7
5351 } 5606 }	Ashepoo Fertilizer	Ashepoo Phosph'te Co., Charles- ton, S. C.	Wadesboro Charlotte	8
5356 } 5612 }	Ashley Acid Phosph'te	Ashley Phosphate Co., Charles- ton, S. C.	Wadesboro Monroe	9
5544 } 5556 }	Atlantic Acid Phos- phate,	Atlantic Phosphate Co., Charles ton, S. C.	Gastonia Lumberton	10
5578	Baker's Stand'd Guano	Chemical Co. of Canton, 32. 34 S. Charles St. Baltimore, Md.	Littleton	11
5387 } 5410 }	Baugh's Animal Bone & Potash Compound	Baugh & Sons' Co., Baltimore, Md.	Oxford Kinston	12
5537	Bono Fertilizer	Bono Fertilizer Co., Balt., Md.	Davidson Col'ge	13
-----	Bos Ammoniated Su- perphosphate,	Wm. Davison & Co., Baltimore, Md.	-----	14
5416 } 5521 }	Bradley's Pat. Super- phosphate of Lime,	Bradley Fertilizer Co., 27 Kilby Street, Boston, Mass.	Wilmington Wake Forest ...	15
-----	British Mixture	Slingluff & Co., 300 W. Fayette St., Baltimore, Md.	-----	16
5562 } 5610 }	Chesapeake Guano ...	Chesapeake Guano Co., 21 P. O. Avenue, Baltimore, Md.	Tarboro Monroe	17
5559	Diamond Soluble Bone	Walton, Whann & Co., Wil- mington, Del.	Salisbury	18

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL- ABLE PHOS. ACID.		Nitrogen.	EQUIVALENT TO AMMONIA.		POTASH.		Relative com. value per ton at the Seaboard.
					F'nd.	Guar't'd.		F'nd.	Guar't'd.	F'nd.	Guar't'd.	
1	11.74	1.71	9.44	4.65	14.09	14	.13	.16	20	-----	-----	\$ 20.27
2	13.20	1.13	6.83	1.07	7.90	8	2.62	3.18	3	2.98	2½	25.45
	13.37	.84	6.67	1.66	8.33	8	2.55	3.10	3	2.55	2½	25.26
3	11.91	3.63	6.65	2.55	9.20	8	2.05	2.49	2	2.19	1	23.97
	12.31	3.29	7.04	1.99	9.03	8	1.99	2.42	2	2.44	1	23.80
4	11.78	.84	8.93	2.17	11.10	8	1.83	2.22	2	3.17	1½	26.89
	14.89	.10	9.71	.41	10.12	8	1.89	2.29	2	3.22	1½	25.82
5	15.12	3.57	6.70	0.66	7.36	9	2.19	2.66	2.75	1.84	1¼	21.56
6	12.53	4.18	6.14	1.91	8.05	8½	2.55	3.10	3	1.34	1½	23.42
7	12.76	2.02	6.23	5.66	11.89	10	---	-----	-----	1.76	1	18.76
8	11.82	5.37	6.40	1.43	7.83	8	2.09	2.54	2	1.90	1	21.88
	13.93	3.90	7.18	1.46	8.64	8	1.99	2.42	2	1.52	1	20.15
9	14.72	1.92	8.48	2.78	11.26	10	-----	-----	-----	1.58	1	17.66
	15.55	2.24	7.80	3.64	11.44	10	-----	-----	-----	1.25	1	17.52
10	13.35	3.65	8.33	2.48	10.81	10	-----	-----	-----	1.73	1	17.21
	13.04	3.11	6.70	4.15	10.85	10	-----	-----	-----	1.36	1	16.82
11	13.12	3.42	3.30	3.90	7.20	8	1.82	2.21	2	2.00	2	19.99
12	13.16	2.67	7.85	1.45	9.30	8	1.50	1.82	2	2.48	2	22.18
	13.92	2.64	5.90	3.05	8.95	8	1.70	2.06	2	2.13	2	22.09
13	11.76	1.92	5.77	3.32	9.09	8	1.71	2.08	2	2.14	1½	22.37
14	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
15	15.89	2.43	7.92	1.93	9.85	9.45	1.93	2.34	2.40	1.79	1	23.89
	13.13	2.51	8.61	1.76	10.37	9.45	2.04	2.48	2.40	1.47	1	24.71
16	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
17	12.89	4.73	4.80	3.26	8.06	9	1.60	1.94	2¼	1.50	1¾	19.68
	13.20	4.18	5.19	3.47	8.66	9	1.71	2.08	2¼	1.15	1¾	20.58
18	12.92	2.43	11.58	1.89	13.47	12	-----	-----	-----	-----	-----	18.86

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
5414	Diamond State Superphosphate,	Lord & Polk, Odessa, Delaware.	Tarboro	19
5459 } 5592 }	Durham Ammoniated Fertilizer,	Durham Fertilizer Co., Durham, N. C.	Gibson's Station. Littleton	20
5746	Durham Ammoniated Fertilizer with Peruvian Guano,	Durham Fertilizer Co., Durham, N. C.	Durham	21
-----	Edisto Acid Phosphate	Edisto Phosphate Co., Charleston, S. C.	-----	22
5539 } 5453 }	Empire Guano	Rasin Fertilizer Co., Box 715, Baltimore, Md.	Shelby Fayetteville	23
5463	Etiwan Ammoniated Superphosphate,	Etiwan Phosphate Co., Charleston, S. C.	Gibson	24
5399 } 5358 }	Etiwan Dissolved Bone	Etiwan Phosphate Co., Charleston, S. C.	Newbern Wadesboro	25
-----	Excellent Ga. Stand'rd	Wilcox & Gibb's Guano Co., Charleston, S. C.	-----	26
5413	Farmers' Bone Fertilizer,	Tarboro Oil Mills, Tarboro, N. C.	Greenville	27
5467 } 5623 }	Farmers' Friend Fertilizer,	Read & Co., 88 Wall St., New York.	Laurel Hill Maxton	28
5591	Farmers' Fr'nd Special Tobacco Fertilizer,	Read & Co., 88 Wall St., New York.	Oxford	29
5624	Game Guano	Baltimore Guano Co., 32 S. Charles St., Baltimore, Md.	Fair Bluff	30
5626	Gem Fertilizer	Acme Manufacturing Co., Wilmington, N. C.	Fair Bluff	31
5466 } 5394 }	Gibbs & Co.'s High Grade Ammoniated Phosphate,	E. J. Powers, Wilmington, N. C.	Laurinburg Wilson	32
5395 } 5456 }	H. S. Miller & Co.'s Harvest Queen,	H. S. Miller & Co., Newark, N. J.	Newbern Warrenton	33
-----	Harvest Queen Phosphate,	Lister's Agricultural Chemical Works, Newark, N. J.	-----	34
5427 } 5452 }	High Grade Premium Guano,	Geo. L. Arps & Co., Norfolk, Va.	Washington ... Dunn	35

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL- ABLE PHOS. ACID.		Nitrogen.	EQUIVALENT TO AMMONIA.		POTASH.		Relative com- value per ton at the Seaboard.
					F'nd.	Guar't'd.		F'nd.	Guar't'd.	F'nd.	Guar't'd.	
19	12.03	1.97	7.20	2.13	9.33	8½	1.65	2.00	1½	1.90	2	\$22.14
20	11.02	1.60	5.71	2.09	7.80	8	1.95	2.37	2¼	2.77	1½	22.30
	13.76	2.72	5.12	2.57	7.69	8	1.75	2.12	2¼	2.14	1½	20.54
21	11.67	2.70	3.85	4.16	8.01	8	2.23	2.71	2¼	2.25	1½	23.13
22	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
23	17.22	1.48	6.17	3.08	9.25	9	1.69	2.05	2.50	1.99	1.75	22.31
	16.51	1.77	6.81	2.09	8.90	9	1.92	2.33	2.50	2.09	1.75	22.89
24	11.47	2.56	6.47	3.70	10.17	8 to 10	1.69	2.05	2 to 2½	2.16	1 to 1½	23.80
25	11.77	2.58	10.13	3.24	13.37	12	-----	-----	-----	-----	-----	18.72
	13.53	3.17	9.29	3.28	12.57	12	-----	-----	-----	-----	-----	17.60
26	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
27	11.72	.91	5.83	1.32	7.15	7½	1.80	2.19	2¼	3.38	2½	21.51
28	14.67	1.85	6.75	1.69	8.44	8½	1.94	2.36	2	2.38	2	22.70
	15.11	1.52	6.18	2.44	8.62	8½	2.06	2.50	2	2.16	2	23.16
29	16.30	2.15	5.41	2.75	8.16	8	2.57	3.12	3	2.97	3	25.60
30	12.77	2.74	4.80	3.36	8.16	8	1.85	2.25	2	1.92	2	21.38
31	12.94	.96	6.68	1.32	8.00	8	1.69	2.05	2	2.83	2	21.57
32	14.19	.87	8.25	1.41	9.66	8.89	1.46	1.77	2.54	1.93	1.73	21.86
	14.21	.88	8.47	1.11	9.58	8.89	1.59	1.93	2.54	1.81	1.73	22.15
33	14.64	.40	10.13	1.06	11.19	10	1.70	2.06	1	2.28	1½	25.41
	14.65	1.02	9.63	1.23	10.86	10	1.74	2.11	1	2.08	1½	24.87
34	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
35	14.28	2.12	7.23	2.42	9.65	8	1.88	2.28	2	1.87	1	23.51
	12.64	5.50	3.31	5.19	8.50	8	2.34	2.84	2	2.32	1	24.34

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
5560 } 5695 }	L. & R. Acid Phosphate,	Lorentz & Rittler, 70 South St., Baltimore, Md.	Concord Rutherfordton ..	36
5541 } 5608 }	L. & R. Ammoniated Guano,	Lorentz & Rittler, 70 South St. Baltimore, Md.	Statesville Monroe	37
5449	Lazaretto Acid Phosphate,	Lazaretto Chem. and Fert. W'ks, G. W. Grafflin, Proprietor, 14 S. Holiday St., Baltimore, Md.	Henderson	38
5396 } 5429 }	Lister's Ammoniated Dissolved Bone Phosphate,	Lister's Agricultural Chemical Works, Newark, N. J.	Newbern Williamston	39
5450	Long's Prepar'd Chemicals,	John R. Long & Co., Baltimore, Md.	Fayetteville	40
5614	Meadows' Spec'l Guano for all Crops,	E. H. & J. A. Meadows, Newbern, N. C.	Newbern	41
5419 } 5554 }	National Fertilizer	S. W. Travers & Co., Richmond, Va.	Maxton Lumberton	42
5400 } 5575 }	Navassa Acid Phosphate,	Navassa Guano Co., Wilmington, N. C.	Wilson Staley	43
-----	N. C. Ammoniat'd Fertilizer,	N. C. Phosphate Co., Raleigh, N. C.	-----	44
5392 } 5411 }	Old Dominion Soluble Guano,	Old Dominion Guano Co., Norfolk, Va.	Wilson Tarboro	45
5455	Owl Brand Guano	Davie & Whittle, Petersburg, Va.	Smithfield	46
5601	Owl Brand Special Tobacco Guano,	Davie & Whittle, Petersburg, Va.	Leaksville	47
5571 } 5574 }	Palmetto Acid Phosphate,	Bradley Fertilizer and Chemical Co., Baltimore, Md.	Wilson Siler City	48
5415	Patapsco Guano	Patapsco Guano Co., 14 S. Holiday St., Baltimore, Md.	Smithfield	49
5464 } 5406 }	Peruvian Guano No. 1, Imported,	Smith & Gilchrist, Wilmington, N. C.	Gibson Wilmington	50
-----	Peruvian Mixture	American Fertilizing Co., Norfolk, Va.	-----	51
5551 } 5607 }	Piedmont Special Fertilizer,	Piedmont Guano Man'f'g Co., 49 South St., Baltimore, Md.	Concord Monroe	52

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL- ABLE PHOS. ACID.		Nitrogen.	EQUIVALENT TO AMMONIA.		POTASH.		Relative com. value per ton at the Seaboard.
					F'nd.	Guar't'd.		F'nd.	Guar't'd.	F'nd.	Guar't'd.	
36	13.77	3.98	10.11	1.44	11.55	12	---	---	---	---	---	\$16.17
	13.06	2.81	11.25	1.97	13.22	12	--	---	---	---	---	18.51
37	14.06	3.12	7.80	1.36	9.16	8	1.44	1.75	2	1.79	1	20.86
	14.20	2.33	8.61	1.02	9.63	8	1.67	2.03	2	1.35	1	22.00
38	16.53	1.96	9.91	2.52	12.43	12.50	---	---	---	---	---	17.40
39	12.83	1.77	7.59	1.94	9.53	9	2.21	2.68	2.20	1.95	1½	24.79
	13.61	1.73	8.01	2.20	10.21	9	2.15	2.61	2.20	1.44	1½	24.90
40	14.36	1.56	11.26	2.15	13.41	12	---	---	---	2.22	1.8	21.44
41	11.65	2.57	6.86	1.97	8.83	9.13	1.92	2.33	2.28	2.73	2.91	23.56
42	10.27	1.87	7.16	2.00	9.16	8	2.17	2.63	2½	2.61	2	24.90
	10.09	1.60	8.75	.46	9.21	8	2.04	2.48	2½	2.38	2	24.18
43	17.61	2.70	8.71	3.88	12.59	13	---	---	---	---	---	17.63
	16.92	3.83	8.83	2.91	11.74	13	--	---	---	---	---	16.44
44	---	---	---	---	see page 34		---	---	---	---	---	---
45	15.39	1.16	6.31	2.76	9.07	8½	1.98	2.40	2¼	2.52	3½	23.88
	14.97	1.15	6.69	1.59	8.28	8½	1.91	2.32	2¼	2.61	3½	22.61
46	16.31	2.92	6.88	1.69	8.57	8	1.74	2.11	2	1.85	1	21.39
47	17.05	3.01	7.92	1.49	9.41	8	2.00	2.43	2½	2.79	2	24.78
48	14.25	2.07	11.50	2.24	13.74	14	---	---	---	---	---	19.24
	14.03	2.09	11.58	1.84	13.42	14	---	---	---	---	---	18.79
49	16.93	2.17	8.15	1.32	9.47	9.25	1.90	2.31	2.50	1.67	1¼	23.12
50	13.41	4.40	7.65	3.69	11.34	13	7.88	9.57	9½	3.26	2	52.33
	14.11	4.40	7.71	3.55	11.26	13	7.76	9.42	9½	3.38	2	51.85
51	---	---	---	---	---	---	---	---	---	---	---	---
52	14.44	1.80	6.88	1.52	8.40	8	1.76	2.14	2	1.69	1	21.06
	15.12	1.88	7.07	1.77	8.84	8	1.66	2.02	2	1.75	1	21.34

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
5586 } 5600 }	Piedmont Guano for Tobacco,	Piedmont Guano Man'f'g Co., 49 South St., Baltimore, Md.	Mt. Airy..... Reidsville.....	53
5403 } 5420 }	Pine Island Ammonia- ted Phosphate,	Quinnipiac Fertilizing Co., New London, Ct.	Wilmington Maxton.....	54
5349 } 5389 } 5393 }	Pocomoke Superphos- phate,	E. B. Freeman & Co., Norfolk, Va.	Wilson Raleigh Wilmington	55
5564 } 5613 }	Prolific Cotton Grower	Goldsboro Oil Co., Goldsboro, N. C.	Wilson Goldsboro	56
5525 } 5590 }	Raleigh Stand'd Guano	Raleigh Oil Mills and Fertilizer Co., Raleigh, N. C.	Wake Forest... Oxford	57
5418 } 5522 }	Raw Bone Superphos- phate Plow Brand,	Walton, Whann & Co., Wil- mington, Del.	Wilmington Wake Forest....	58
5538	Red Navassa Guano, Ammoniated,	Navassa Guano Co., Wilming- ton, N. C.	Shelby	59
5545	Reese's Dissolved Bone Phosphate (formerly Pacific),	Jno. S. Reese & Co., Baltimore, Md.	Gastonia	60
5587 } 5589 }	Reese's A 1 Guano.....	Jno. S. Reese & Co., Baltimore, Md.	Thomasville Littleton	61
5454 } 5585 }	Roanoke XX Ammo- niat'd Sup'rph'sph'te	Benj. H. Read, Baltimore, Md.	Fayetteville Thomasville	62
5558 } 5374 }	Royster's High Grade Acid Phosphate,	Royster & Strudwick, Norfolk, Va.	Salisbury	63
5402 } 5421 }	Sea Fowl Guano (BD)-	Bradley Fertilizer Co., 27 Kilby St., Boston, Mass.	Wilmington Maxton.....	64
5405 } 5747 }	Slingluff's Dissolved Bone for Home Fer- tilizer,	Boykin, Carmer & Co., Balti- more, Md.	Wilmington Leaksville	65
5407 } 5457 }	Soluble Pacific Guano	Jno. S. Reese & Co., Baltimore, Md.	Wilmington Henderson	66
5566	Special Cotton Com- pound,	G. Ober & Sons' Co., 85 Exch'ge Place, Baltimore, Md.	Wilson	67
5388 } 5583 }	Special Compound for Tobacco, Phosphate and Alkalies,	G. Ober & Sons' Co., 85 Exch'ge Place, Baltimore, Md.	Oxford	68
5372 } 5584 }	Star Brand Guano....	Allison & Addison, 1322 Cary St., Richmond, Va.	Selma	69
			Winston.....	

	Water.	Insoluble Phos. Acid.	Soluble Phos. Acid.	Reverted Phos. Acid.	TOTAL AVAIL- ABLE PHOS. ACID.		Nitrogen.	EQUIVALENT TO AMMONIA.		POTASH.		Relative com. value per ton at the Seaboard.
					F'nd.	Guar't'd.		F'nd.	Guar't'd.	F'nd.	Guar't'd.	
53	16.62	1.55	7.07	.80	7.87	8	2.28	2.77	2½	4.91	3	\$ 26.33
	14.04	1.98	6.27	1.63	7.90	8	2.59	3.14	2½	4.49	3	27.12
54	21.19	1.04	6.35	3.52	9.87	8	1.90	2.31	2	1.66	1	23.66
	21.32	1.56	6.49	2.79	9.28	8	2.04	2.48	2	1.74	1	23.51
55	14.46	2.01	6.98	1.62	8.60	8½	1.68	2.04	2	1.94	1½	21.30
	17.84	2.14	8.26	.31	8.57	8½	1.94	2.36	2	1.81	1½	22.19
	17.72	2.14	7.88	1.05	8.93	8½	1.85	2.25	2	1.74	1½	22.24
56	11.63	2.20	5.71	1.79	7.50	9	2.44	2.96	2½	3.15	2	24.34
	11.56	2.47	5.45	1.32	6.77	9	2.26	2.74	2½	3.32	2	22.78
57	10.98	2.26	6.14	.89	7.03	9	2.48	3.01	3	1.99	2¼	22.46
	12.51	2.32	5.69	1.06	6.75	9	2.38	2.89	3	2.20	2¼	21.92
58	12.72	2.90	7.22	1.55	8.77	9	2.42	2.94	2¼	2.71	1¾	25.53
	12.58	2.98	7.29	2.86	10.15	9	2.36	2.87	2¼	2.56	1¾	27.04
59	14.49	1.61	7.93	2.72	10.65	9	1.82	2.21	2	2.14	1.25	24.99
60	14.66	5.45	6.61	4.10	10.71	10	---	---	---	---	---	14.49
61	21.95	2.66	1.42	7.10	8.52	8	1.94	2.36	2	1.32	1	21.54
	21.15	3.16	1.42	6.59	8.01	8	1.99	2.42	2	1.31	1	21.01
62	15.77	2.12	5.60	3.35	8.95	8	1.64	1.99	2	3.16	1½	23.09
	16.78	2.38	6.78	1.70	8.48	8	1.75	2.12	2	2.12	1½	21.62
63	10.83	1.69	8.84	2 17	11.01	11¼	---	---	---	---	---	15.41
	12.04	.70	7.10	3.15	10.25	11¼	---	---	---	---	---	14.35
64	13.57	1.74	8.70	2.07	10.77	9.45	2.02	2.45	2.40	1.58	1	25.30
	13.98	2.01	8.79	1.80	10.59	9.45	1.90	2.31	2.40	1.56	1	24.55
65	12.98	2.69	9.76	2.29	12.05	13.50	.91	1.10	2	---	---	19.90
		0.90	9.72	2.57	12.29	13.50	2.01	2.44	2	---	---	25.50
66	14.07	3.79	5.80	1.49	7.29	8½	2.09	2.54	2.35	1.60	1.20	20.76
	13.63	2.94	5.99	1.91	7.90	8½	2.22	2.70	2.35	2.11	1.20	22.77
67	13.86	2.79	6.96	2.13	9.09	8	1.71	2.08	2	1.87	1.40	22.04
68	11.67	2.66	7.37	1.68	9.05	8	2.47	3.00	2¼	3.43	2	26.99
	14.17	2.96	7.93	1.37	9.30	8	2.25	2.73	2¼	3.03	2	25.94
69	14.62	1.98	7.10	1.86	8.96	8	1.90	2.31	2	1.75	1¼	22.50
	15.51	2.01	7.14	1.28	8.42	8	1.90	2.31	2	1.63	1¼	21.60

Station No.	NAME.	ADDRESS OF MANUFACTURER OR GENERAL AGENT.	SAMPLED AT	
5524	Star Brand Special Tobacco Manure,	Allison & Addison, 1322 Cary St., Richmond, Va.	Durham	70
5543 } 5373 }	Stonewall Brand Fertilizer,	Jas. G. Tinsley & Co., Richmond, Va.	Gastonia Selma	71
5354 } 5398 }	Stono Acid Phosphate.	Stono Phosphate Co., Charleston, S. C.	Laurinburg Newbern	72
5350 } 5390 }	Stono Soluble Guano.	Stono Phosphate Co., Charleston, S. C.	Laurinburg Newbern	73
5602	Tinsley's Tobacco Fertilizer,	Jas. G. Tinsley & Co., 1326 Cary St., Richmond, Va.	Ruffin	74
5555	Walker's Ammoniated Phosphate,	Joshua Walker, 13 German St., Baltimore, Md.	Lumberton ...	75
-----	Wando Acid....	Wando Phosphate Co., Charleston, S. C.	.....	76
5609	Wando Soluble Guano	Wando Phosphate Co., Charleston, S. C.	Monroe	77
5401 } 5359 }	Wilcox, Gibbs & Co.'s Acid Phosphate,	Wilcox & Gibbs Guano Co., 78 E. Bay St., Charleston, S. C.	Washington Laurinburg	78
5397 } 5353 }	Wilcox, Gibbs & Co.'s Manipulated Guano,	Wilcox & Gibbs Guano Co., 78 E. Bay St., Charleston, S. C.	Washington ... Laurinburg	79
5565 } 5627 }	Zell's Ammon'd Bone Superphosphate,	Zell Guano Co., Baltimore, Md.	Wilson Maxton	80
-----	Zell's Tobacco Fertiliz'r	Zell Guano Co., Baltimore, Md.	.....	81

N. C. AMMONIATED FERTILIZER.

	No. 5783. Sampled at Raleigh.	No. 5784. Sampled at Raleigh.	Claimed.
Moisture	4.58	4.53	
Total Phosphoric Acid. Not available by laboratory methods	6.22	7.69	9½
Nitrogen, equivalent to ammonia	2.29	2.17	2½
Potash	2.28	2.26	2¼

CHEMICAL DIVISION.

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[illegible]

TOBACCO PRODUCTS FOR FERTILIZING PURPOSES.

The following analyses are given to show the relative value of the various tobacco products which may be useful for fertilizing purposes. It is interesting to observe the variation between the tobacco stems of this and other States. The large content of potash in the Western stems prove that this crop in those States must be much more exhaustive to the soil than the tobacco grown here. It is noteworthy also that so large a quantity of the potash present is soluble in water. Occurring in an organic material, it would hardly be expected that from 90 to 98 per cent. of the total potash present is soluble in water. Yet such is the case.

The samples were kindly furnished by the Durham Fertilizer Company, Durham, N. C., who are responsible for the samples and marks given to each.

5900. Missouri stems, White Burley Tobacco, used for manufacturing chewing tobacco.

5901. Kentucky stems, White Burley Tobacco, used for manufacturing chewing tobacco.

5902. Ohio stems, White Burley Tobacco, used for manufacturing chewing tobacco.

5903. Virginia stems, dark heavy shipping, or "Export Tobacco."

5904. Virginia stems, dark heavy shipping, or "Export Tobacco."

5905. North Carolina stems, "Bright Lugs," for cigarettes.

5906. North Carolina stems, "Bright Lugs," for cigarettes short.

5907. Stalk of bright North Carolina bright tobacco.

5923. North Carolina, used for chewing tobacco, before casing.

5924. North Carolina stems, used for chewing tobacco, after casing.

5925. North Carolina stems from smoking tobacco.

5926. Dust from smoking tobacco factory—poor sample, as it contains a larger quantity of sand than usual.

TOBACCO PRODUCTS FOR FERTILIZING PURPOSES.

Station Number.		Moisture.	Volatile and Organic Matter.	Crude Ash.	Per cent. Phosphoric Acid.	Per cent. Ammonia.	Per cent. Water Soluble Potash.	Per cent. Total Potash.	Per cent. Water Soluble in Total Potash.
5900	Missouri stems for chewing tobacco	16.56	61.65	21.79	.82	3.06	8.44	9.08	92.95
5901	Kentucky stems for chewing tobacco	16.85	61.69	21.46	.72	2.89	8.36	8.89	94.04
5902	Ohio stems for chewing tobacco	15.70	62.17	22.13	.84	3.47	8.11	8.56	94.63
5903	Virginia stems for shipping or export tobacco	16.20	63.72	20.08	.56	3.14	6.35	7.00	90.71
5904	Virginia stems for shipping or export tobacco	17.15	63.80	19.05	.43	2.15	5.25	5.63	93.25
5905	North Carolina stems for cigarettes	18.18	65.86	15.96	.51	.93	4.97	5.33	93.15
5906	North Carolina stems for cigarettes short	15.90	65.80	18.30	.58	1.71	4.11	4.19	98.09
5907	Stalk of Bright N. C. Tobacco	17.36	71.78	10.86	.52	2.11	3.92	4.34	90.32
5923	North Carolina stems for chewing tobacco before casing	16.75	67.40	15.85	.73	1.19	3.37	3.66	92.08
5924	North Carolina stems, for chewing tobacco after casing*	12.42	70.29	17.29	.43	1.82	4.27	4.55	93.84
5925	North Carolina stems, short, from smoking tobacco	16.00	67.16	16.84	.59	1.14	4.80	5.14	93.38
5926	North Carolina dust from Smoking Tobacco Factory, poor sample	9.04	48.68	42.28	.87	1.49	1.67	1.97	84.77

*This sample being wet when received, was air-dried, which accounts for the increased percentage.

MARLS.

Below are given locations of beds and analysis of each, samples of which were sent to the Station during the year.

5370. A. J. Kilpatrick, Kinston, N. C. Marl.

5527. Robt. Pitt, St. Lewis, N. C. Marl. The marl is about four feet from surface and about twelve or fifteen feet thick, and seems to be about fifty or sixty yards wide and about half mile in length.

5528. Robt. Pitt, St. Lewis, N. C. Same location as 5527.

5594. G. W. Lamb, Chinquepin, N. C. Marl, marked "fine" about the depth of ten feet and about fifty yards wide.

5595. G. W. Lamb, Chinquepin, N. C. Marl, marked "coarse" from same bed.

5596. W. B. Dawson, Conetoe, N. C. Marl. Bed belongs to J. H. Clark, and was dug from his land in Pitt County; is about five feet from the top of the land and about nine feet deep.

5618. E. N. Robeson, Tar Heel, N. C. Marl. "Whole farm seems to be underlaid with it."

5647. W. B. Southerland, Rose Hill, N. C. Marl, lies about four feet from surface.

5717. B. T. Mooring, Jason, N. C. Marl.

5992. Peyton Page, Page, N. C. Supposed blue marl.

6146. Daniel Moore, Warsaw, N. C. Supposed Marl.

6041. B. F. Sutton, LaGrange, N. C. Marl. Four feet from surface, the top petrified for twelve inches or more.

6153. H. W. Malloy, Wilmington, N. C. Shell Marl.

6162. Dr. J. M. Kirkpatrick, LaGrange, N. C. Marl. From plantation near Goldsboro, N. C.

Station No.	SENDER AND ADDRESS.	Sand and In-soluble Matter, per cent.	Carbonate of Lime, per cent.	Phosphate of Lime, per cent.
5370	A. J. Kilpatrick, Kinston, N. C.	-----	81.50	.70
5527	Robt. Pitt, St. Lewis, N. C.	63.80	27.29	2.99
5528	Robt. Pitt, St. Lewis, N. C.	33.18	57.65	2.74
5594	G. W. Lamb, Chinquepin, N. C.	14.21	74.24	2.74
5595	G. W. Lamb, Chinquepin, N. C.	62.58	2.91	1.65
5596	W. B. Dawson, Conetoe, N. C.	59.77	23.52	4.22
5618	E. N. Robeson, Tar Heel, N. C.	50.10	44.38	1.09
5647	W. B. Southerland, Rose Hill, N. C.	7.01	90.74	-----
5717	B. T. Mooring, Jason, N. C.	80.88	2.59	3.80
5992	Peyton Page, Page, N. C.	90.29	Trace.	Trace.
6146	Daniel Moore, Warsaw, N. C.	83.42	-----	6.71
6041	B. F. Sutton, LaGrange, N. C.	72.48	5.25	1.87
6153	H. W. Malloy, Wilmington, N. C.	25.36	56.39	.67
6162	Dr. J. M. Kirkpatrick, LaGrange, N. C.	-----	24.27	1.42

POTABLE WATERS.

The following samples of potable waters have been received during the year. In the majority of cases these samples were suspected of containing some impurities. The analyses, therefore, do not indicate the general character of the drinking waters of the State. The analytical work was done according to Wanklyn, and the conclusions from the results were drawn according to the rules laid down by that writer.

ANALYSES OF SUSPECTED DRINKING WATERS.

Station Number.	RECEIVED FROM.	GRAINS PER U. S. GALLON.			PARTS PER MILLION.		REMARKS.
		Solids.	Chlorine.	Hardness, Equiv. to Carbonate Lime.	Free Ammonia.	Albuminoid Ammonia.	
5634	Dr. Jas. McKee, Raleigh (Well on premises Julius Crawford).	8.00	1.33	1.50	0.778	.1020	Suspicious.
5683	Thos. H. Houghton, Charlotte.	4.10	.441	2.00	.0218	.0938	Good, safe water.
5752	Dr. Jas. McKee, Raleigh	.90	.37	.00	.0998	.0760	Fair, safe water.
5753	Dr. Jas. McKee, Raleigh	7.9	.61	3.00	.4104	.1834	Dangerous.
5755	Geo. A. Woodard, Wilmington (From Gregory Institute).	8.00	.94	4.00	.055	.0916	Good, safe water; slightly hard.
5933	Dr. Hubert Haywood, Raleigh (Milburnie well).	6.1	.6	1.4	.66	.22	Exceedingly contaminated,—decidedly suspicious.
5934	Dr. H. Haywood, Raleigh (Neuse River).	5.80	.6	1.1	.16	.12	Organic contamination,—suspicious.
5936	M. L. John, John Station (From a well on premises of J. T. John, John Station, N. C.)	2.5	.5	1.	.076	.12	Somewhat suspicious.
5988	Dr. J. M. Baker, Tarboro (From Spout Spring, Tarboro).	3.84	.68	1.1	.082	.22	Suspicious.
6049	Dr. L. H. Reid, Williamston	3.33	.83	1.00	.054	.062	Good, safe water.
6068	D. P. Hutchinson, Charlotte	6.17	1.08	2.00	.176	.216	Suspicious.
6074	W. R. Crawford, Steward (Insane Asylum, Raleigh)	6.00	.749	2.30	.032	.136	Somewhat suspicious.
6078	Dr. J. M. Baker, Tarboro (Factory well).	9.91	2.42	2.33	.098	.110	Organic contamination,—somewhat suspicious.
6079	Dr. J. M. Baker, Tarboro (Factory spring).	4.67	0.5	0.33	.106	.100	Some organic contamination,—rather suspicious.

ANALYSES OF SUSPECTED DRINKING WATERS.—CONTINUED.

Station Number.	RECEIVED FROM.	GRAINS PER U. S. GALLON.			PARTS PER MILLION.		REMARKS.
		Solids.	Chlorine.	Hardness, Equiv. to Carbonate Lime.	Free Ammonia.	Albuminoid Ammonia.	
6080	Dr. J. M. Baker, Tarboro (Well, Dr. Cheshire's).	4.91	.08	.42	.096	.102	Some organic contamination,—rather suspicious.
6081	Dr. J. M. Baker, Tarboro (Well, Madra's).	8.00	.92	2.83	.08	.19	Organic contamination,—suspicious.
6082	Dr. J. M. Baker, Tarboro (Cistern, Litchensien's).	5.08	.25	1.75	.042	.142	Organic contamination,—somewhat suspicious.
6083	Dr. J. M. Baker, Tarboro (Water-works creek).	3.33	.42	.33	.112	.140	Organic contamination,—suspicious.

PAMUNKEY MARL PHOSPHATE.

For sometime during the year a company known as the Pamunkey Marl and Phosphate Company, of Richmond, Va., have been selling, in this State, a fertilizing material called the "Pamunkey Marl Phosphate." Not being a manipulated fertilizer it is not liable to a license tax, provided it is not sold under a proprietary brand or trade-mark. At first, through ignorance, the company were selling under a trade-mark, but when the matter was called to their attention by the Commissioner of Agriculture, the trade-mark was promptly omitted from the bags.

As it is not subject to a license, it does not come under the requirements of the law in having to be sampled by the official inspector, analyzed, and the analysis published. For this reason no analysis was included in the official list. Several samples, however, were received from private sources and analyzed, with the result recorded below. No guaranteed claim has been stamped on the bags. The circulars of the company have been so adroitly written that they contain no expressed guarantee, and only imply one by recording analyses by several of the most eminent authorities in the United States. Under the head of "A Few Facts," occur these words: "Now, if you purchase three tons of the Marl Phosphate at \$10 per ton, * * and allow that the marl only analyze 8 per cent. of Phosphoric Acid and 2 per cent. of Potash," etc. Any one would at least expect, even if there is no expressed guarantee, that the Marl Phosphate would contain 8 per cent. of Phosphoric Acid and 2 per cent. of Potash. Yet what were the results of the analyses? Station No. 5761 was received from a private source at Lockville. No. 5748 was taken from a bag in Charlotte, and was in a very moist condition; the other bags in this lot, consisting of 60 or 70, appearing to be fully as wet as from that taken. Sample No. 5723 was received from Wilson.

ANALYSES OF PAMUNKEY MARL PHOSPHATE.

No.	Received from	Moisture.	Phos. Acid.	Carb. Lime.	Potash.	Sand.
5761	Lockville	1.28	1.80	16.03	.56	71.66
5748	Charlotte	11.82	1.75	4.52	.75	74.96
5723	Wilson	1.78	1.84	4.78	not det.	81.22

The potash given is that *soluble in acid*, and consequently shows all the potash present in the marl. A strict determination of this ingredient, according to the method employed in the usual analysis of commercial fertilizers, would most probably have shown *no* potash.

Presuming that sample 5748 was accidentally wet, and the sample was not a fair one on that account, the following calculation is made, reducing the moisture content to 1.50 per cent, which is about the

average of the other two samples. The result will now be, comparing with the lowest implied guarantee:

ANALYSES OF PAMUNKEY MARL PHOSPHATE.

No.	Rec'd from	Moisture.	Phos. Acid.		Carb. Lime.	Potash.		Sand.
			Im. Guar.	Found.		Im. Guar.	Found.	
5761	Lockville	1.28	8.00	1.80	16.03	2.00	.56	71.66
5748	Charlotte	1.50	8.00	1.95	5.04	2.00	.83	83.58
5723	Wilson	1.78	8.00	1.84	4.78	2.00	----	81.22

The above analyses of samples from totally different localities indicate that the Marl Phosphate, in round numbers, in two cases, four-fifths of the whole is sand; in the third case, in round numbers, three-fourths of the whole is sand. For a ton, which costs \$10.00, and freight probably added, a farmer pays \$7.00 to \$8.00 for 1,500 lbs. to 1,600 lbs. of sand. Can he afford it?

Judging from the analyses, there are a hundred marl-pits in Eastern North Carolina each of which would show a better analysis, and, if applied to the soil, would show a better yield than this Pamunkey Marl Phosphate. It is doubtful whether the value is sufficient to pay the freight alone on this grade of goods.

DOES STABLE MANURE IN DRYING LOSE ANY OF ITS AMMONIA?

F. B. DANCY.

It was determined to make an experiment with a view to ascertaining whether or not an ordinary manure pile, exposed to the atmosphere, would lose any of its supply of ammonia in slowly drying out.

To this end a miniature manure heap was made, using 100 grams of well-rotted horse-stable manure. The sample was quite wet, being more than half water. [58.70 per cent. exactly.]

Through this miniature heap a slow current of perfectly dry ammonia-free air was passed until the manure had completely dried. It was so arranged that the current of air, in passing through the manure, thoroughly permeated the mass of the pile. It required three weeks for the heap to completely dry. The air, after passing through the heap, was conducted through a measured quantity [20 c. c.] of standard acid solution in a U tube, the strength of which solution had been previously determined.

At the end of the three weeks, the manure heap being then thoroughly dried, the standard acid was then taken out and titrated with standard alkali, when it was found that 1.62 c. c. of the stand-

ard acid had been neutralized during the passage of the air from the manure heap through it. On the supposition that this neutralization was caused by ammonia escaping from the drying heap, it would correspond to 0.01377 per cent. of ammonia [NH_3], or 0.01134 per cent. of nitrogen [N].

It was observed toward the close of the experiment, when the manure was almost perfectly dry, that the current of dry air, obtaining no moisture from the manure, passed into the standard acid in an almost absolutely dry state, and consequently evaporated the standard acid solution. In order to see what effect such evaporation might have on the strength of the standard acid solution, another portion [20 c. c.] was measured out, and a current of dry ammonia-free air was conducted slowly through this portion, without the intervention of the manure. When it had evaporated about as much as was the case in the previous experiment,—which required about two days,—the acid was titrated as before. No change was found to have occurred, hence it is apparent that whatever change had taken place in the acid in the direct experiment with the manure, was due to the partial decomposition of the manure itself.

The total amount of ammonia in the manure before the drying was begun was found to be 0.41 per cent., and the loss during the three weeks of drying was 0.01377 per cent., equal to 3.36 per cent. of the whole amount of ammonia originally present.

As there is no other apparent cause to which the change in the strength of the standard acid can be ascribed, it would appear from the experiment that manure slowly drying in the air loses a very small amount of its content of ammonia. This loss, however, is so slight that, practically, it is inappreciable.

This experiment, it must be remembered, was with *well-rotted* stable manure, where active fermentation had already taken place. The result most probably would have been different with *fresh, unrotted* manure, in which case slow fermentation in presence of air, would most likely have resulted in a greater loss of ammonia. On this point it is purposed, in time, to conduct another experiment; that is, using fresh instead of rotted manure.

FEEDING VALUE OF SOME FORAGE PLANTS AND GRASSES.

B. W. KILGORE.

In 1887 experiments were made on the farm in the growth of some forage plants and grasses, to determine their yield per acre, the influence of different manures, and their adaptability to this soil and climate. It was also planned that a portion of the work should include the analysis of the plants and grasses to determine

their relative feeding value. The former portion of the experiment was completed and the results published in the Report of 1887. The latter is, in part, embraced herewith.

Table I contains the results of the analyses of twenty-two (22) forage plants, grains and grasses, made in the laboratory, together with their approximate nutritive ratios. The analyses of "cow-pea vines" and of "hay from mixed meadow grasses," are taken from the Connecticut Station Report. They are averages of six and nine analyses respectively, and are inserted for convenience in comparing feeding values.

EXPLANATION OF RESULTS.

Moisture.—By moisture is meant mechanically adhering or hygroscopic water, which is driven off at the temperature of boiling water. It was determined by drying a weighed quantity of the substance in a current of dry hydrogen gas, at a temperature of 100° C., for six hours.

Pure Ash—represents the residue left after burning the substance till all volatile matter is driven off. It is composed mainly of soda, potash, lime and magnesia, in the form of phosphates, sulphates and chlorides. Carbon dioxide was deducted in the determination.

Ether Extract—is the term given to whatever is dissolved by ether, free from alcohol and water. It is composed mainly of fat, but contains also small quantities of gum and coloring matter.

Albuminoids—are the nitrogenous compounds of the plant. They contain an average of about 16 per cent. of nitrogen and are estimated by determining the nitrogen and multiplying the result by 6.25. They are represented in the animal body by lean meat, muscles, tendons, and tissues.

Crude Fiber, or Cellulose—is the part of the plant which is insoluble in weak acid and alkali. The cell walls of the plant are composed chiefly of cellulose. The lint of cotton is almost pure cellulose. Its composition is similar to that of starch. It is the most indigestible part of a food-stuff, but when digested is considered of equal value to starch and sugar. Nitrogen-free extract and crude fiber, taken together, are known as carbohydrates.

Nitrogen-free Extract—is the term applied to those non-nitrogenous portions of the plant which are represented in the main by sugar, starch and gum. It is the remainder of the plant, and is determined by estimating the difference between the whole and the sum of the above five constituents.

FUNCTIONS OF THE NUTRIENTS.

Albuminoids, fats, and carbohydrates are called nutrients, each of which has its own office to perform in the animal economy. The

albuminoids are the producers of flesh, muscles, sinews, and all portions of the animal machine which has strength, except the bones. The fats and carbohydrates perform the same office in the body—that of the production of the heat and force by which the animal mechanism is run. The ash, or mineral matter, furnishes the materials for the bony structure. Thus, each nutrient has its specific office to perform in the animal nutrition. If, therefore, an excess of one, or of all, the constituents be fed, the loss will be clear and in proportion to the excess; while a deficiency will show itself, on the other hand, in the deteriorated condition of the animal. The economic value of such analyses as are here given, is to show the farmer the composition of these feeding materials, thus giving him some idea of the amount of the different nutrients he is feeding. In Bulletin 64 of this Station was printed a table showing the amounts of the different nutrients which practical experience has proven best suited to the different animals under different conditions. This amount is known as a *Ration*. For detailed information, reference must be made to this bulletin. In this ration, experience has also shown that it is necessary to have regard to the relations which the different nutrients bear to each other. This is known as the

NUTRITIVE RATIO,

and is the ratio which the digestible albuminoids bear to the digestible fats x $2\frac{1}{2}$ and the digestible carbohydrates. Fats, when burned, produce 2.5 times as much heat as carbohydrates, and as the office of both is the production of heat and force, fats are worth 2.5 times more.

It is seen from the above, that to determine the true nutritive ratio it is necessary to know the digestibility. In this respect the nutritive ratios in this table are at fault, and represent only approximate ratios, the digestibility not being known. The ratios were calculated from actual results given by analysis. It is thought, however, that this will be of practical value, as digestion often takes place in such proportions as not to materially change the ratio from what is shown by actual chemical analysis. Clover-hay has a nutritive ratio of 1 to 5.6, calculated from the proportion of digestible nutrients, while the one obtained from results of analysis is 1 to 5.7. In the same way, cow-pea vines have ratios of 1 to 4.6 and 1 to 5.

EXPLANATION OF TABLES.

The maize-corn, whole plant, was cut while the leaves were yet green, but the grain was moderately hard. The ear, stalk and fodder were ground, well mixed, and analysis made of the mixture. Kaffir corn head, white millo-maize head, and yellow millo-maize head, were well matured heads of these respective plants. These,

together with the Kaffir flour and middlings, were samples sent to the Station by Mr. Jasper Stowe, of Belmont, N. C. Kaffir middlings, as designated in the table, is a mixture of middling, shorts and bran, or all of the grain except the flour. The cotton stalks, burrs, and roots were pulled up from the field after the cotton had been picked. All the rest of the plants were harvested in the hay state. The high feeding value of the cotton stalks is especially noteworthy.

Table II gives the total yield per acre of the forage plants and grasses, together with the number of pounds per acre of organic matter, mineral matter and moisture contained in each; also the amount in pounds of the food constituents yielded by an acre of each. This table is based on the yield of these crops at the Experiment Farm, and consequently represents the condition only at this special location. The yield in other localities might be materially different, which would necessarily alter the figures in Table II.

TABLE I.—ANALYSES OF GRASSES AND FORAGE PLANTS, GROWN MAINLY ON EXPERIMENT FARM.

Station Number.	NAME.	NO. OF POUNDS IN 100 OF						Nutritive Ratio.
		Moisture.	Pure Ash.	Ether Extract.	Albuminoids, N×6.25.	Nitrogen-free Extract.	Crude Fiber.	
4578	Dhoura Corn.....	10.26	5.72	1.76	4.44	44.41	33.41	1:18.5
5981	Maize—whole plant.....	7.26	7.50	2.98	4.94	54.16	23.16	1:17.1
4584	Kaffir Corn—whole plant.....	10.94	5.48	2.50	3.31	47.40	30.37	1:25.3
6397	Kaffir Corn—head.....	16.23	2.02	2.86	6.92	65.16	6.79	1:11.4
6398	Kaffir Flour.....	16.75	2.18	3.82	6.62	69.47	1.16	1:12.1
6399	Kaffir Middlings.....	16.72	1.46	2.68	8.62	69.43	1.09	1: 8.9
6400	White Millo-Maize—head.....	15.66	1.75	2.81	8 18	63.15	8.45	1: 9.6
6401	Yellow Millo-Maize—head.....	15.66	2.68	2.79	7.62	62.78	8.47	1:10.2
4583	Broom-Corn.....	9.41	5.74	1.85	3.87	42.37	36.76	1:22.6
4587	Sorghum, Early Orange.....	10.02	3.42	5.47	3.69	49.64	27.76	1:24.6
4581	Sorghum, Early Amber.....	10.49	4.17	4.27	5.20	45.19	30.68	1:16.6
4577	German Millet.....	10.82	6.39	1.83	6.75	47.61	26.60	1:11.6
4580	Pearl Millet.....	9.90	12.35	1.66	8.31	33.04	34.74	1: 8.6
4586	Pearl Millet—headed.....	9.27	8.55	1.60	7.15	38.01	35.42	1:10.8
4582	Hungarian Millet.....	9.92	8.77	2.71	10.62	45.60	22.38	1:7
4147	Cow-Pea Vines.....	14.54	7.56	1.75	12.56	39.91	23.68	1: 5.4
.....	*Cow-Pea Vines.....	.....	8.41	2.87	15.68	42.17	19.80	1: 4.4
6097	Lucerne.....	12.42	6.96	2.18	15.25	33.77	29.42	1: 4.5
6155	Italian Rye Grass.....	10.00	13.48	3.08	13.50	30.36	29.58	1:5
4579	Johnson Grass.....	10.50	8.20	2.28	7.44	40.49	31.09	1:10.3
4585	Fowl Meadow Grass.....	10.12	6.54	2.30	8.69	44.42	27.93	1:9
6098	Grass.....	7.40	10.98	2.30	7.00	45.21	27.11	1:11
6396	Cotton Stalks, Burrs and Roots.....	12.77	7.75	2.27	7.31	42.35	27.55	1:10.3
.....	*Hay from mixed Meadow Grasses.....	.....	4.71	2.05	6.24	40.43	31.09	1:12.2

*Taken from Connecticut Experiment Station Report.

TABLE II.—YIELD OF FOOD CONSTITUENTS PER ACRE, FROM GRASSES AND FORAGE PLANTS GROWN AT EXPERIMENT FARM.

Station Number.	NAME.	Total yield in pounds per acre of air-dried hay.	HAY COMPOSED, IN POUNDS PER ACRE, OF			ORGANIC MATTER COMPOSED, IN POUNDS PER ACRE, OF			
			Organic Matter.	Mineral Matter.	Moisture.	Albuminoids, N \times 6.25.	Ether Extract.	Nitrogen-free Extract.	Crude Fiber.
4578	Dhoura Corn	9.120 —	7662.6	521.6	935.7	404.9	160.5	4050.1	3046.9
4584	Kaffir Corn	3.770 —	3151.0	206.6	412.4	124.8	94.3	1786.9	1144.9
4587	Sorghum, Early Orange...	4.576 —	3962.0	156.5	458.5	168.9	250.3	2271.5	1270.3
4581	Sorghum, Early Amber....	4.360 —	3720.9	181.8	457.3	226.8	186.2	1970.3	1337.7
4577	German Millet	3.156 —	2613.0	201.6	341.4	213.0	57.8	1502.6	839.5
4580	Pearl Millet	6.806 —	5291.8	840.5	673.7	565.6	112.9	2248.7	2364.4
4582	Hungarian Millet	1.369 —	1113.2	120.0	135.8	145.4	37.1	624.3	306.4
4147	Cow-Pea Vines*	1.893 —	1474.7	143.1	275.2	237.8	33.1	755.5	448.3
4579	Johnson Grass	5.139	4178.2	421.3	539.5	332.4	117.2	2080.8	1597.7
4585	Fowl Meadow Grass	1.907	1589.4	124.7	192.9	165.8	43.9	847.1	532.6

*Yield low and sample poor.

REPORT OF DIVISION OF CO-OPERATIVE FIELD EXPERIMENTS.

Co-operative Field Tests have been conducted during the year, similar to those of 1888. That this work is very essential, may easily be understood from the very diverse character of the soils of the State, made up as they are from the oldest Laurentian and Huronian rocks of the Middle and Western portions of the State, down to the more recent Tertiary and Quaternary formations of the Eastern section. The elevation of the lands embraced by various altitudes, from the high mountains to the seacoast, makes it very evident that the results of the field work of one locality, if it were conducted only in one place, would far from represent other points. The value, then, of co-operative field work in different localities, can easily be seen. It brings together results from various points for comparison and consideration, instead of accepting as final the result of work from one single point. Another item of consideration is the increased possibility of interesting farmers in the immediate neighborhood of the different localities, and thereby disseminating more widely whatever value the work may have.

The object of these experiments is two-fold. 1st. To analyze the soil and ascertain what in its contents will be useful to the plant. 2d. To discover what elements, or combination of elements, are most necessary to the growth of a certain crop. As nitrogen, phosphoric acid, and potash are most needed by plants, and as these ingredients are liable to be easily exhausted from the soil, it is always the endeavor to supply them, singly or together, in some of their combinations, to make good any deficiency. To test this question, these ingredients, by ones, twos, or threes, are applied to similar portions of the soil, the crops observed on each, and from the results from these separate portions or plots it can be decided what ingredients give the best result, or, which is the same thing, what ingredient is most needed by the soil. Also by comparing the results from many different localities, the elements most needed by the plant can be approximately defined.

The fertilizing ingredients, to be added to the plots most correctly and scientifically, should *only* be the ingredients enumerated above, without any admixture of foreign elements; in other words, the purest form of chemicals which contain *only* what it is desired to use. For, in this case the effect of the application can be ascribed only to the one constituent, without being affected by any of the other foreign elements.

But for many reasons, for these co-operative experiments, it was thought best to choose, instead of pure chemicals, such of the ingre-

dients in common use having a predominance of the fertilizing elements desired. While the results will not be scientifically correct, yet they will be sufficiently accurate to suit the ends of the experiments. Instead, therefore, of using the chemicals, sulphate of ammonia, nitrate of soda, to furnish the nitrogen or ammonia, sulphate of potash to furnish the potash, and so on with other chemicals—the ordinary fertilizing ingredients, acid phosphate, cotton-seed meal and kainit have been adopted for the purpose of furnishing phosphoric acid, nitrogen and potash respectively as their predominant elements. They contain, as well, certain other ingredients in small proportion, but these have but little effect on the crop, as compared with the predominant constituent.

The detailed plan of the experiments and the instructions sent to each experimenter were fully set forth on pages 60 and 62, Report of 1888, and need not be inserted again. The plots for 1889, however, were one-twentieth of an acre each in extent, instead of one-tenth, as the year before.

The fertilizing ingredients were sent to each experimenter, and were uniform in quality throughout the series.

The acid phosphate, furnishing available phosphoric acid, cost in the Raleigh market \$18.50 per ton, which value was uniformly used in estimating the gain and loss in the results. On analysis, it yielded—

Moisture.....	17.63	per cent.
Soluble phosphoric acid	9.86	"
Reverted phosphoric acid.....	2.46	"
Available phosphoric acid.....	12.32	"
Insoluble phosphoric acid	2.02	"

The cotton-seed meal, furnishing nitrogen (or ammonia) principally, cost \$24 00 per ton, and on analysis gave—

Total phosphoric acid.....	2.48	per cent.
Nitrogen.....	6.86	"
Equivalent to ammonia.....	8.33	"
Potash.....	1.64	"

The kainit, furnishing potash as the valuable ingredient, cost \$14.00 per ton, and contained—

Potash.....	12.72	per cent.
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The stable manure is valued at 75 cents per two-horse load.

In order to test the value of a new fertilizer which was being extensively sold in the State, an additional plot (No. 22) was added. This fertilizer, licensed under the name of N. C. Ammoniated Fertilizer, was sold by a home firm, the N. C. Phosphate Company. The basis of ammonia and potash in it was such as are used in the ordinary commercial fertilizers. The phosphoric acid was obtained from phosphate from the mines of the company at Castle Haynes, N. C., and was untreated with sulphuric acid. It was, consequently, a fertilizer containing ground undissolved phosphate mixed with ingredients furnishing ammonia and potash.

It was claimed by this company that the phosphoric acid was available in the field, if not in the laboratory, and they gave practical experiences of farmers to prove this assertion. The Station was continually asked if this statement could be relied on. Not being in a position either to disprove or to credit this claim, field tests were planned and were carried out during the year. Comparison can be thus made with the ordinary combination of fertilizing ingredients with available phosphoric acid, or with any of these ingredients separately.

The N. C. Ammoniated Fertilizer cost in Raleigh \$20.00 per ton, and yielded on analysis—

Moisture.....	3.42 per cent.
Total phosphoric acid, not "available" in laboratory	7.89 "
Nitrogen.....	1.81 "
Equivalent to ammonia	2.20 "
Potash.....	2.30 "

It was applied at the rate of 500 lbs. to the acre.

The following table will give the application and cost of each ingredient, together with the amount of chemical constituent in each, all calculated per acre. Of these, Nos. 3 and 13 will represent the average grade of commercial fertilizer as sold in the State, and will analyze approximately 8 per cent. available phosphoric acid, 2.50 per cent. ammonia, and 2.50 per cent. of potash:

PER ACRE.

Number.	APPLICATION IN POUNDS.				CONTAINING POUNDS.			COST.
	Acid Phosphate.	C. S. Meal.	Kainit.	Total.	Avail'ble Phosphoric Acid.	Nitrogen	Potash.	
1	400	-----	-----	400	49.28	-----	-----	\$ 3.70
2	-----	-----	-----	None	-----	-----	-----	0.00
3	300	150	70	525	36.96	10.29	11.36	5.07
4	-----	500	-----	500	-----	34.30	8.20	6.00
5	-----	-----	400	400	-----	-----	50.88	2.80
6	300	200	-----	500	36.96	-----	3.28	5.18
7	300	-----	200	500	36.96	-----	25.44	4.18
8	20 2-h	orse loads	s stable	manure	-----	-----	-----	15.00
9	-----	250	250	500	-----	17.15	35.90	4.75
10	200	200	200	600	24.64	13.72	28.72	5.65
11	-----	-----	-----	None	-----	-----	-----	0.00
12	300	-----	-----	300	36.96	-----	-----	2.78
13	200	100	50	350	24.64	6.86	8.00	3.40
14	-----	400	-----	400	-----	27.44	6.56	4.80
15	-----	-----	300	300	-----	-----	38.16	2.10
16	200	100	-----	300	24.64	6.86	1.64	3.05
17	-----	-----	-----	None	-----	-----	-----	0.00
18	200	-----	150	350	24.64	-----	19.08	2.90
19	-----	200	200	400	-----	13.72	28.72	3.80
20	100	100	100	300	12.32	6.86	14.36	2.82
21	10 2-h	orse loads	s stable	manure	-----	-----	-----	7.50
22	N. C. Ammoniated Fertilizer	500	-----	500	39.45*	9.05	11.50	5.00

*Total Phosphoric Acid, and not available by laboratory methods.

EXPERIMENTERS.

Following is a list of those who have been selected, and who kindly consented to co-operate in the work of the Station by conducting field experiments in their localities:

EASTERN DISTRICT.

W. L. Barlow	Tarboro	Edgecombe County.
Dr. D. Cox	Hertford	Perquimans County.
F. R. Johnston	Plymouth	Washington County.
T. L. Jones	Columbia	Tyrrell County.
E. F. Lamb	Elizabeth City	Pasquotank County.
E. Meares	Clarkton	Bladen County.
J. B. Oliver	Mt. Olive	Wayne County.
W. H. Shields	Scotland Neck	Halifax County.
O. W. Sutton	Mt. Olive	Wayne County.
Dr. R. P. Thomas	Bethlehem	Hertford County.
H. Clay Williams	Willeyton	Gates County.
J. G. Williams	Edenton	Chowan County.
Dr. R. W. Wooten	Kinston	Lenoir County.

CENTRAL DISTRICT.

C. N. Allen	Auburn	Wake County.
H. B. Hunter, Sr.	Ridgeway	Warren County.
T. J. King	Louisburg	Franklin County.
T. B. Lindsay	Douglas	Rockingham County.
R. D. Lunceford	Smithfield	Johnston County.
Prof. A. McIver	Pittsboro	Chatham County.
J. C. Williams	Winslow	Harnett County.

WESTERN DISTRICT.

H. C. Dunn	Clear Creek	Cabarrus County.
W. E. Ardrey	Pineville	Mecklenburg County.
J. C. Cooper	Dobson	Surry County.
Lee Crawford	Franklin	Macon County.

RESULTS OF CO-OPERATIVE FIELD WORK, SEASON OF 1889.

The results of the co-operative field work for 1889 is given in the following pages. Unfortunately, the year was extremely bad for all growing crops. The four months following the planting of all the staple crops, viz.: May, June, July and August, were far above the average in the amount of precipitation. Then followed a period of partial drouth, lasting through the remaining growing season. The excessive rain-fall of the early portion, and the deficiency thereafter, dwarfed the growth of cotton and prevented complete maturity before the occurrence of a destructive frost in the early portion of October. Corn was not so badly damaged, except in the low grounds. In the counties embraced by the cotton tests, the cotton crop was cut off one-third to one-half, and in some localities as much as two-thirds. This last was more especially the case with low, sandy soils of the East.

Under these conditions it is easy to see how unsatisfactory was all field work, and especially so with comparative field tests, which should have as few disturbing elements as possible. The results for 1889 will not be valueless, however, as it is interesting to ascertain what is the effect of the various applications of fertilizing ingredients as altered by these disturbing conditions of abnormal rain-fall, drouth and early frost.

The effect of the applications are noted in tabular form as *increased yield*, as compared with the average of the three unfertilized plots; next, as *net money gain*, and *net loss*, comparing again with the unfertilized plots after subtracting the cost of the application; and third, as *rank*, in which is noted the variation between the best and worst application as measured by the net gain and the net loss. No other expense than that of application is considered. It will be remembered that as the plots were $\frac{1}{20}$ acre in extent, a consideration *per acre* will magnify twenty-fold any variation of the original plot.

In connection with each report, deductions from the results are included, which may serve to give, in a general way, the effect of the application on the crop. It must be remembered that these results are far from conclusive. The season, the soil, and the possible error of work may have some decided effect on the results. And it would be hardly proper to claim that the same results might certainly be looked for at other localities. Their bearing, in a great measure, is local, and must be considered as far from being conclusive. It is hoped, however, that the lessons gained from the experiments may not be without some value.

FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY E. MEARES, CLARKTON, BLADEN COUNTY, N. C.

Character of Land:—Nearly level; soil uniform. Drainage good. In cotton previous year, with 225 pounds guano per acre.

FIELD NOTES:—Instead of three rows to a plot, had one long row. Length 136 hills $4\frac{1}{2}$ feet apart; width between rows $3\frac{1}{2}$ feet. No vacant row left between plots. Seed raised at home. Planted April 6th. May 14th, plowed and applied fertilizers; 21st, plowed with cotton sweep; 30th, light plowing with turning plow. Weather very dry, nights cool. This retarded growth. June 13th, ran sweep in middles; 18th, sided every other middle with sweep; 26th, sided other middles; 8th and 9th, hoed out crop nicely.

PER 0.983 ACRE.

[Net gain and net loss show comparison with average of the unfertilized plot, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Corn in Ear, Pounds.	Value.	Increas'd Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	1173	\$ 10.05	139	\$ -----	\$ 2.53	14
2	-----	-----	-----	.00	1034	8.88	-----	-----	-----	4
3	300	150	70	5.08	1104	9.48	70	-----	4.48	17
4	-----	500	-----	6.00	1385	11.88	351	-----	3.00	15
5	-----	-----	400	2.80	1104	9.48	70	-----	2.20	10
6	300	200	-----	5.18	1380	11.82	346	-----	2.24	12
7	300	-----	200	4.18	1360	11.64	326	-----	1.42	8
9	-----	250	250	4.74	1110	9.52	80	-----	4.10	16
10	200	200	200	5.64	1586	13.59	552	-----	.93	7
12	300	-----	-----	2.78	1104	9.48	70	-----	2.18	9
13	200	100	50	3.40	1172	10.04	138	-----	2.24	12
14	-----	400	-----	4.80	1586	13.59	552	.09	-----	3
15	-----	-----	300	2.10	758	6.50	*276	-----	4.48	17
16	200	100	-----	3.04	1104	9.48	70	-----	2.44	13
18	200	-----	150	2.90	1306	11.19	272	-----	.59	5
19	-----	200	200	3.80	1725	14.76	891	2.08	-----	1
20	100	100	100	2.82	1380	11.82	346	.12	-----	2
21	10 2-horse loads manure	-----	stable	7.50	1650	14.16	616	----	2.22	11
22	500 N.C. Ammoniated Fertilizer (Phosphate not soluble by laboratory method)	-----	-----	5.00	1518	13.02	484	-----	.86	6

*Decrease.

Deductions from the results :

1. Applications, with few exceptions, proved unremunerative.
2. Cotton-seed meal alone, and in combination with kainit, gave best results.
3. Acid phosphate alone proved a poor application.
4. Application of kainit showed, in one case, a small increase; in another, a decrease, as compared with unfertilized plot, and was unremunerative.

FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY H. CLAY WILLIAMS, WILLEYTON, GATES COUNTY, N. C.

Character of Land.—Nearly level; soiled mixed and somewhat light and sandy; drainage good, ditched on side and end. In cotton previous year, with 40 bushels cotton seed, 300 pounds raw-bone meal and 100 pounds kainit per acre. Previous yield 1,000 to 1,450 pounds seed cotton.

FIELD NOTES.—Rows 121 yards long, 4 feet apart, being one-tenth acre each, and double application of fertilizer. Instructions carried out, except that on Plot 8, ten one-horse loads of compost, and on Plot 21 five one-horse loads compost were used. Seed mixed. Planted May 1st: 17th plowed with sulky cultivator and with 5-hoe cultivator, and thinned and grassed with hoes; 30th, partial cultivation with plow. Wet weather retarded growth on side of ridge. June 4th, finished plowing with sulky cultivator; 5th, ran "Iron-age" 5-hoe cultivator between rows; 6th, planted black peas in vacant rows; 19th, hilled with turning plow and removed suckers. Rain has damaged crop in sandy places. Looking well on the whole and beginning to tassel. July 19th, finished cultivation; crop good, but injured by wet weather, which lasted most of the season.

PER ONE ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Corn in Ear, Pounds.	Value.	Increas'd Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	1400	\$ 12.00	17	\$.-----	\$ 3.57	18
2	-----	-----	-----	.00	1420	12.18	-----	-----	-----	4
3	300	150	70	5.08	1580	13.56	197	-----	3.39	16
4	-----	500	-----	6.00	2260	19.38	877	1.57	-----	1
5	-----	-----	400	2.80	1540	13.20	157	-----	1.47	9
6	300	200	-----	5.18	1940	16.62	555	-----	.43	7
7	300	-----	200	4.18	1540	13.20	155	-----	2.85	13
8	100 1-horse loads	compost	-----	-----	2240	19.20	857	-----	-----	-----
9	-----	250	250	4.74	1940	16.62	557	-----	.01	6
10	200	200	200	5.64	1860	15.96	477	-----	1.55	10
11	-----	-----	-----	.00	1440	12.36	-----	-----	-----	3
12	300	-----	-----	2.78	1300	11.16	*83	-----	3.49	17
13	200	100	50	3.40	1500	12.84	117	-----	2.43	11
14	-----	400	-----	4.80	1980	16.98	597	.31	-----	2
15	-----	-----	300	2.10	1280	10.98	*103	-----	2.99	14
16	200	100	-----	3.04	1380	11.82	*3	-----	3.09	15
17	-----	-----	-----	.00	1290	11.07	-----	-----	-----	5
18	200	-----	150	2.90	1300	11.16	*83	-----	3.61	19
19	-----	200	200	3.80	1500	12.84	117	-----	2.83	12
20	100	100	100	2.82	1620	13.86	237	-----	.83	8
21	50 1-horse loads	compost	-----	-----	1860	15.96	477	-----	-----	-----

* Decreased yield.

Deductions from the results:

1. Applications, with few exceptions, proved unremunerative.
2. Kainit and acid phosphate alone or combined showed poor yield, and in some cases a decrease as compared with unfertilized plots.
3. Cotton seed meal alone was best application, and in combination yielded well.
4. Compost gave excellent results. Cost not being stated, comparative value is not given.

FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY PROF. ALEXANDER MCIVER, PITTSBORO, CHATHAM COUNTY, N. C.

Character of Land:—High, slightly sloping; clay, gravelly soil. Not cultivated previous year. Had yielded six bushels wheat per acre.

FIELD NOTES:—Instructions fully carried out. Rows between plots were planted but not fertilized. Seed, procured at a store, not good. Planted April 25th. May 21st, plowed, hoed and replanted. Dry weather retarded germination. June 15th, plowed, hoed and replanted. No rain from April 27th to May 31st. About one-fourth first planting came up. After rain of May 31st it began to improve, and is doing well. July 11th, plowed and hoed. General condition good; lacks sunshine; cloudy and raining nearly the whole month. August, weather wet and favorable for corn, especially on red clay land like this.

PER ONE ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Corn in Ear, Pounds.	Value.	Increas'd Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	1200	\$ 10.27	273	-----	\$ 1.38	20
2	-----	-----	-----	.00	900	7.71	-----	-----	-----	15
3	300	150	70	5.08	1860	15.96	933	2.93	-----	10
4	-----	500	-----	6.00	2140	18.36	1213	4.41	-----	7
5	-----	-----	400	2.80	1220	10.40	293	-----	.35	17
6	300	200	-----	5.18	2520	21.60	1593	8.47	-----	1
7	300	-----	200	4.18	2120	18.18	1193	6.05	-----	2
8	20 2-horse loads manure	stable	stable	15.00	2840	24.36	1913	1.41	-----	12
9	-----	250	250	4.74	2040	17.51	1113	4.82	-----	5
10	200	200	200	5.64	2360	19.22	1433	5.63	-----	3
11	-----	-----	-----	.00	920	7.89	-----	-----	-----	14
12	300	-----	-----	2.78	1180	10.09	253	-----	.64	18
13	200	100	50	3.40	1840	15.78	915	4.43	-----	6
14	-----	400	-----	4.80	2080	17.82	1153	5.07	-----	4
15	-----	-----	300	2.10	1020	8.75	93	-----	1.30	19
16	200	100	-----	3.04	1260	10.76	333	-----	.23	16
17	-----	-----	-----	.00	960	8.25	-----	-----	-----	13
18	200	-----	150	2.90	1760	15.06	833	4.21	-----	8
19	-----	200	200	3.80	1680	14.40	753	2.65	-----	11
20	100	100	100	2.82	1660	14.22	733	3.45	-----	9
21	10 2-horse loads manure	stable	stable	7.50	1640	14.04	715	--	1.41	21

Deductions from the results:

1. Soil was uniform, and responded well to fertilizers.
2. Acid phosphate and kainit proved unremunerative.
3. Cotton-seed meal alone and in combination gave fine results.
4. Stable manure increased the yield largely, but hardly commensurate with its value.

FIELD EXPERIMENTS WITH CORN.

CONDUCTED BY LEE CRAWFORD, FRANKLIN, MACON COUNTY, N. C.

Character of Land:—Rolling upland; soil nearly uniform, clayey. In wheat previous year without fertilizer. Had been in clover, corn and wheat; yield not ascertained.

FIELD NOTES:—Instructions carried out except that rows were three and a half feet apart instead of four, and rows between plots were planted though not fertilized. Seed raised at home. Planted April 23d. Plowed and hoed twice; May 15th. (deep plowing) and May 28th. (plowed with cultivator). Weather dry; corn small and yellowish. Fertilizing shows plainly in some of the plots. June 16th, plowed and hoed—a thorough working. Dry weather during first half of month. During last half, fine showing; weather caused great improvement. July 18th, plowed with cultivator and well hoed. Some smut, but no insects. Crop is looking well and helped by rainy weather. August, no cultivation; wet weather has been very favorable for this crop, many changes in appearance since last report.

PER SEVEN-EIGHTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Corn in Ear, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	2700	\$ 23.16	1099	\$5.69	\$-----	4
2	-----	-----	-----	.00	1620	13.88	-----	-----	-----	13
3	300	150	70	5.08	3120	26.74	1513	7.89	-----	3
4	-----	500	-----	6.00	2620	22.46	1013	2.68	-----	7
5	-----	-----	400	2.80	2500	21.42	893	4.85	-----	5
6	300	200	-----	5.18	2500	21.42	893	2.47	-----	9
7	300	-----	200	4.18	2160	18.51	553	.56	-----	11
8	20 2-horse loads manure	stable	stable	15.00	1500	12.85	*107	-----	15.92	21
9	-----	250	250	4.74	1680	14.40	73	-----	4.11	20
10	200	200	200	5.64	1800	15.42	193	-----	3.99	19
11	-----	-----	-----	.00	1400	12.00	-----	-----	-----	14
12	300	-----	-----	2.78	3480	29.82	1873	3.27	-----	1
13	200	100	50	3.40	3160	27.06	1553	9.89	-----	2
14	-----	400	-----	4.80	2720	23.23	1113	4.71	-----	6
15	-----	-----	300	2.10	2000	17.16	393	1.29	-----	10
16	200	100	-----	3.04	2400	20.58	793	3.77	-----	8
17	-----	-----	-----	.00	1800	15.42	-----	-----	-----	12
18	200	-----	150	2.90	1500	12.84	*107	-----	3.83	18
19	-----	200	200	3.80	2000	17.16	393	-----	.41	16
20	100	100	100	2.82	1900	16.26	293	-----	.33	15
21	10 2-horse loads manure	stable	stable	7.50	2180	18.66	573	-----	2.61	17

* Decreased yield.

Deductions from the results:

1. Soil responded well to most applications.
2. Acid phosphate alone gave best returns.
3. The complete mixture (3 and 13) yielded excellent results.
4. Kainit alone, and with acid phosphate, was not satisfactory.
5. Cotton-seed meal alone, and in combination with acid phosphate, gave fair results.
6. Stable manure yielded badly; in large applications actually causing a decreased yield, compared with unfertilized plots.

FIELD EXPERIMENTS WITH CORN AND TOBACCO.

CONDUCTED BY T. B. LINDSAY, DOUGLAS, ROCKINGHAM COUNTY, N. C.

Character of Land.—Level and uniform, natural drainage. Soil poor, rather porous, mixed with sand and gravel. Has been uncultivated for several years. Last crop was rye; yield 5 bushels per acre.

FIELD NOTES :—Plots marked off equal to $\frac{1}{50}$ acre each. Fertilizer intended for $\frac{1}{20}$ acre applied to two of these plots; one being planted in corn and the other in tobacco. Corn planted April 30th; tobacco planted May 31st. Hoed and replanted corn during May once. Weather dry; corn came up badly. June 7th, hoed; 17th, hoed and plowed; 28th, used "Iron-Age" Cultivator. Wet weather has injured crop much. July 1st, plowed deep with shovel plow and hoed. Wet weather has almost ruined crops. Corn, tobacco, wheat and oats are much injured; prospect discouraging. August, crop in bad condition—fired at bottom. Dissatisfied with results. Acid phosphate and cotton-seed meal act well on land.

PER FOUR-FIFTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application].

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		INCREASE.		Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Ears of Corn.	Pounds of Tobacco	Ears of Corn.	Pounds of Tobacco	
1	400	-----	-----	\$ 3.70	1960	200	1140	110	--
2	-----	-----	-----	.00	820	80	-----	-----	--
3	300	150	70	5.07	1700	170	880	80	--
4	-----	500	-----	6.00	1740	160	920	70	--
5	-----	-----	400	2.30	1800	190	980	100	--
6	300	200	-----	5.18	1840	195	1020	105	--
7	300	-----	200	4.18	1760	160	940	70	--
8	20 2-horse loads	stable	man're	15.00	1720	150	900	60	--
9	-----	250	250	4.75	1580	140	760	50	--
10	200	200	200	5.65	2060	210	1240	120	--
11	-----	-----	-----	.00	780	90	-----	-----	--
12	300	-----	-----	2.78	1200	120	380	30	--
13	200	100	50	3.40	1780	180	960	90	--
14	-----	400	-----	4.80	1640	170	820	80	--
15	-----	-----	300	2.10	1660	170	840	80	--
16	200	100	-----	3.05	1720	170	900	80	--
17	-----	-----	-----	.00	860	100	-----	-----	--
18	200	-----	150	2.90	1540	160	720	70	--
19	-----	200	200	3.80	1660	170	840	80	--
20	100	100	100	2.82	1700	170	880	80	--
21	10 2-horse loads	stable	man're	7.50	1000	110	180	20	--
22	500 N. C. Ammoniated Fertilizer, [Phosphate not soluble by laboratory methods.]	-----	-----	5.00	1740	170	920	80	--

Approximate deductions from the results :

1. No weights of corn are given, and a value can scarcely be placed on the tobacco. No just comparison can be made.

2. Applications appear to be beneficial.

SUMMARY OF EXPERIMENTS WITH CORN, SEASON OF 1889.

In the following table is given a summary of results of the field tests with corn in the counties of Bladen and Gates in the Eastern section, in Chatham in the Central, in Macon in the Western section. Comparison is made not entirely on the basis of increased yield due to the various applications, but to the increased yield taken in connection with the cost of the application necessary to produce this increase. In other words, the financial consideration is made to predominate—the question being, *What application pays best?*

In the table the heavy type expresses the net gain, and ordinary type the net loss, in money value, as compared with unfertilized plots, after subtracting the cost of application.

The result is more favorable than for 1888. Then the applications, with but few exceptions, proved unremunerative. For this season a much larger number yielded good returns. The wet weather, for the most part, during the season was rather favorable to the growth of corn. This fact must be remembered in considering the relative values of the different ingredients and the combined applications. It would appear that the wet weather retarded the effect of acid phosphate and kainit, and increased that of cotton-seed meal. For, without exception, cotton-seed meal, in both large and small applications, increased the yield materially, and proved remunerative. This effect extended to the combination of meal with other ingredients. Acid phosphate alone in all cases, except one, increased the yield but slightly and proved unremunerative. In combination with meal the result was better, but with kainit the yield was not sufficient to be remunerative. Kainit alone was generally quite unsatisfactory in both large and small applications. The complete fertilizer, represented by Nos. 3 and 13 (about equivalent to the usual grade of commercial fertilizer), in the main proved satisfactory.

SUMMARY OF RESULTS OF EXPERIMENTS WITH CORN.

[Heavy type expresses the net gain, and ordinary type the net loss, in money value, as compared with unfertilized plots after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Bladen County. Average Soil, Level and Drain'd. Per .983 Acre.	Chatham County, Clay, Gravelly Soil. Per Acre.	Gates County. Soil Mixed, Light and Sandy. Per Acre.	Macon County. Clay Soil, Nearly Uniform. Rolling Upland. Per $\frac{1}{8}$ Acre.
	Acid Phos- phate.	C. S. Meal.	Kainit.				
1	400	-----	-----	\$ 2.53	\$ 1.38	\$ 3.57	\$ 5.69
2	-----	-----	-----	-----	-----	-----	-----
3	300	150	70	4.48	2.93	3.39	7.89
4	-----	500	-----	3.00	4.41	1.51	2.63
5	-----	-----	400	2.20	.35	1.47	4.85
6	300	200	-----	2.24	8.47	.43	2.47
7	300	-----	200	1.42	6.05	2.85	.56
8	20 2-horse loads	stable manure	-----	-----	1.41	-----	15.92
9	-----	250	250	4.10	4.82	.01	4.11
10	200	200	200	.93	5.63	1.55	3.99
11	-----	-----	-----	-----	-----	-----	-----
12	300	-----	-----	2.18	.64	3.49	13.27
13	200	100	50	2.24	4.43	2.43	9.89
14	-----	400	-----	.09	5.07	.31	4.71
15	-----	-----	300	4.48	1.30	2.99	1.29
16	200	100	-----	2.44	.23	3.09	3.77
17	-----	-----	-----	-----	-----	-----	-----
18	200	-----	150	.59	4.21	3.61	3.83
19	-----	200	200	2.08	2.65	2.83	.41
20	100	100	100	.12	3.45	.83	.33
21	10 2-horse loads	stable manure	-----	2.22	1.41	-----	2.61
22	500 N. C. Ammoniated Fertilizer, (Phosphate not soluble by laboratory methods.)	-----	-----	.86	-----	-----	-----

FIELD EXPERIMENT WITH WHEAT—COMPARISON OF VARIETIES.

CONDUCTED BY LEE CRAWFORD, FRANKLIN, MACON COUNTY.

This experiment was designed to test the applicability of several varieties of wheat under like conditions of soil and climate. The location of the experiment was in one of the mountain counties, in the extreme Western portion of the State.

The soil used was a loose clay, and a fair representative of the upland soil of the locality, and had not been highly fertilized previously. The normal productive quality was about ten bushels of wheat to the acre. Size of plots was 20 x 109 feet, which corresponded to one-twentieth acre almost exact. Two feet was allowed for walks between plots. The land was turned about one month before sowing, thoroughly pulverized with the Acme harrow, without the addition of fertilizer of any kind. The wheat was sown with a drill Nov. 10th, 1888, at the rate of one bushel per acre. Time of ripening and cutting varied from June 27th to July 2d, 1889. The dry weather of the Spring of 1889 materially reduced the yield. In converting the yield to bushels, the uniform rate of sixty pounds per bushel was used. The test showed for the special soil and climate, that Fulcaster, Lancaster & Everett High Grade were the best, with some slight evidence in favor of the Lancaster.

YIELD OF VARIETIES OF WHEAT, MACON COUNTY.

PLANTED NOVEMBER 10TH, 1888.

Varieties.	Appearance in Spring 1889 100=best plot.	Time of Cutting.	YIELD IN POUNDS.		Yield in Bushels Per Acre.
			Per $\frac{1}{20}$ Acre Plot.	Per Acre.	
1. Davis	78	June 28, 1889...	28	560	9.33
2. Kivet	85	June 28, 1889...	45	900	15.
3. Baltimore or Boughton...	75	June 27, 1889...	35	700	11.66
4. Fulcaster ...	90	June 27, 1889...	50	1000	16.66
5. Lancaster ...	90	June 27, 1889...	51	1020	17.
6. Tappahannock	80	June 27, 1889...	31	620	10.33
7. Everett High Grade	100	June 27, 1889...	50	1000	16.66
8. Martin's Ambr	83	July 2, 1889...	35	700	11.66
9. Garfield	63	July 2, 1889...	25	500	8.33
10. Golden Cross.	60	June 27, 1889...	32	640	10.66
11. Mediterranean Hibrid	87	July 2, 1889...	30	600	10.
12. Surprise	86	June 27, 1889...	35	700	11.66

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY F. R. JOHNSTON, PLYMOUTH, WASHINGTON COUNTY, N. C.

Character of Land.—Medium good cotton land; soil stiff, drainage good. In corn previous year with no manure; yield, three barrels corn.

FIELD NOTES.—Instructions generally carried out, except width of rows was 3½ feet. Planted May 8th. Seed good. No cultivation during May, on account of excessive rain, which had damaging effect on crop. *June*: Crops almost a failure on account of heavy rains; very difficult to determine condition. *July*: Hoed three times during month; plowed four times. *August*: Find cotton-seed meal to be equal to, or better than, raw seed. *Results*: Great loss to all farmers on account of the exceeding wetness of the season. Nothing could be fairly tested.

PER SEVEN-EIGHTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	360	\$ 10.80	67	\$ -----	\$ 1.70	15
2	-----	-----	-----	.00	280	8.40	-----	-----	-----	7
3	300	150	70	5.07	400	12.00	107	-----	1.87	17
4	-----	500	-----	6.00	600	18.00	307	3.20	-----	1
5	-----	-----	400	2.80	360	10.80	67	-----	.80	12
6	300	200	-----	5.18	400	12.00	107	-----	1.98	18
7	300	-----	200	4.18	400	12.00	107	-----	.98	14
8	20 2 horse loads manure,	stable	-----	15.00	600	18.00	307	-----	5.80	20
9	-----	250	250	4.75	500	15.00	207	1.45	-----	2
10	200	200	200	5.65	500	15.00	207	.55	-----	4
11	-----	-----	-----	.00	300	9.00	-----	-----	-----	6
12	300	-----	-----	2.78	360	10.80	67	-----	.78	11
13	200	100	50	3.40	400	12.00	107	-----	.20	8
14	-----	400	-----	4.80	500	15.00	207	1.40	-----	3
15	-----	-----	300	2.10	300	9.00	7	-----	.90	13
16	200	100	-----	3.05	400	12.00	107	.15	-----	5
17	-----	-----	-----	.00	300	9.00	-----	-----	-----	6
18	200	-----	150	2.90	300	9.00	7	-----	1.70	15
19	-----	200	200	3.80	400	12.00	107	-----	.60	10
20	100	100	100	2.82	400	12.00	107	-----	.38	9
21	10 2 horse loads manure,	stable	-----	7.50	400	12.00	107	-----	4.30	19
22	500 N. C. Ammoniated Fertilizer, (Phosphate not soluble by laboratory methods.)	-----	-----	5.00	400	12.00	107	-----	1.80	16

Deductions from the results:

1. Soil was uniform, but did not respond well to fertilizers.
2. Cotton seed meal alone, and in combination with kainit, proved a good application and was remunerative.
3. Acid phosphate and kainit, separately and combined, increased the yield but slightly.
4. Stable manure application gave but slight increase.
5. N. C. Ammoniated Fertilizer increased the yield but slightly, about equal to application of kainit and meal.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY DR. R. P. THOMAS, BETHLEHEM, HERTFORD COUNTY, N. C.

Character of Lands:—Level and nearly uniform. Stiff soil; in corn previous year, with cotton-seed application. Yield in corn had been about 12 bushels.

FIELD NOTES:—Instructions carried out, except that width of rows was three feet nine inches, instead of four. No additional plots planted. Seed were "Ozier." Planted May 3d; 30th, scraped, chopped and dirted. Excessive rains and storms seriously damaged the crops. *June*: Plowed and hoed three times during the month; weather exceedingly wet. *July*: Plowed and hoed three times during the month; very rainy month. *August*: Plowed once; very rainy month, especially first half. In absence of superintendent a tenant unwittingly picked over Section B (embracing plots 12 to 22), hence it is impossible to render report on results for these plots.

PER $\frac{15}{16}$ ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application].

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	670	\$ 20.10	170	\$ 1.40	\$.-----	6
2	-----	-----	-----	.00	530	15.90	-----	-----	-----	7
3	300	150	70	5.07	780	23.40	380	3.33	-----	2
4	-----	500	-----	6.00	840	25.20	340	4.20	-----	1
5	-----	-----	400	2.80	575	17.25	75	-----	.55	9
6	300	200	-----	5.18	750	22.50	250	2.32	-----	4
7	300	-----	200	4.18	615	18.45	115	-----	.73	10
8	8,000 lbs comp	stable ost,	manure	3.20	655	19.65	155	1.45	-----	5
9	-----	250	250	4.75	620	18.60	130	-----	1.15	11
10	200	200	200	5.65	780	23.40	280	2.75	-----	3
11	-----	-----	-----	.00	470	14.10	-----	-----	-----	8

Deductions from the results:

1. Cotton-seed meal alone, and in combination, gave excellent results.
2. Kainit alone, and in single combination, proved unremunerative.
3. Complete fertilizer of No. 3, gave good yield.
4. Acid phosphate gave an increased yield.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY O. W. SUTTON, MT. OLIVE, WAYNE COUNTY, N. C.

Character of Land:—High, dry and undulating; sandy loam with clay sub-soil. Not cultivated previous year. Had been in corn and pease.

FIELD NOTES:—Instructions carried out, with the following exceptions: Length of row 60 yards; width of rows $3\frac{1}{2}$ feet; no vacant row left between plots; instead of leaving plots 2 and 17 unfertilized, used a mixture generally used on other crops. Seed—"Peerless." Planted April 24th. Well worked during May. Cool and wet weather set crops back. *August*: Plots containing cotton-seed meal began to grow very rapidly when rains set in, and still have a green appearance. *Result*: Plots 1, 2, 3 and 4, are at the bottom of a slope and the rest on the slope, so that the test is not an accurate one.

PER SEVEN-EIGHTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400			\$ 3.70	440	\$ 13.20	60	\$	\$ 1.90	20
2	250	[10 bus. cot. s'd]	125	4.98	630	18.90	250	2.52		10
3	300	150	70	5.07	750	22.50	370	6.05		2
4		500		6.00	720	21.60	340	4.20		5
5			400	2.80	570	17.10	190	2.90		8
6	300	200		5.18	780	23.40	400	6.82		1
7	300		200	4.18	590	17.70	210	2.12		12
8	250	[10 bus. cot. s'd]	125	4.98	720	21.60	340	5.22		3
9		250	250	4.75	600	18.00	220	1.85		13
10	200	200	200	5.65	630	18.90	250	1.85		13
11				.00	380	11.40				18
12	300			2.78	480	14.40	100	.22		17
13	200	100	50	3.40	650	19.50	270	4.70		4
14		400		4.80	520	15.60	170		.60	19
15			300	2.10	330	9.90	*50		3.60	21
16	200	100		3.05	510	15.30	130	.85		16
17	250	[10 bus. cot. s'd]	125	4.98	600	18.00	220	1.62		14
18	200		150	2.90	530	15.90	150	1.60		15
19		200	200	3.80	600	18.00	220	2.80		9
20	100	100	100	2.82	580	17.40	200	3.18		7
21	250	[10 bus. cot. s'd]	125	4.98	660	19.80	280	3.42		6
22	500 N.C. Ammoniated Fertilizer, (Phosphate not soluble by laboratory method)			5.00	620	18.60	240	2.20		11

*Decrease.

Deductions from the results:

1. Soil proved very responsive to nearly every application.
2. Acid phosphate alone proved of slight value.
3. Complete fertilizer of Nos. 3 and 13 proved very remunerative.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY J. C. WILLIAMS, WINSLOW, HARNETT COUNTY, N. C.

Character of Land.—Ordinary, unimproved; gently sloping three ways, readily drained by rows; soil light, sandy loam, of uniform character. In cotton previous year, with 200 pounds commercial fertilizer per acre. Former yield of corn here had been 12 or 14 bushels per acre.

FIELD NOTES.—Instructions carried out, except that width of rows was 3 feet. Planted May 22d. Seed, Peterkin, of own cultivation; 25th, chopped to a stand and replanted; sided with large sweep cotton plows, plowed also the middles. No rain during May, consequently growth was slow and the stand a bad one. No. 8 is much the most vigorous. No. 21, and all others where acid phosphate was used as a component, are about the same in appearance, and in good condition. None of the materials do well alone, kainit being the poorest, cotton-seed meal next, and acid phosphate best. June 6th, hoed and sided again with cotton plow; 17th, plowed with large sweeps; 20th, hoed. Present condition unfavorable for crops. July 9th, hoed; 10th, plowed with cotton plows, large sweep; 24th, plowed with same plow. Plots quite uniform in appearance except 4 and 14 where cotton-seed meal alone was used. These retain their color notwithstanding wet weather and slow growth. Plot 6, which looked so well before the rainy season, has since depreciated. Owing to excessive rains the crops are not looking well. Plants unhealthy; leaves dropping off; bolls and squares sparse. August, plots 4 and 14 still look best, but the fruiting of all seems to be about equal. Excessive rains, commencing June 28th and continuing through July, damaged the crop very much, it being planted on light, sandy soil.

PER THREE-FOURTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	320	\$ 9.60	175	\$ 1.55	\$.----	16
2	-----	-----	-----	.00	140	4.20	-----	-----	-----	20
3	300	150	70	5.07	460	13.80	315	4.38	-----	10
4	-----	500	-----	6.00	335	10.05	190	-----	.30	22
5	-----	-----	400	2.80	230	6.90	185	-----	.25	21
6	300	200	-----	5.18	400	12.00	255	2.47	-----	14
7	300	-----	200	4.18	440	13.20	295	4.67	-----	9
8	20 2-horse loads manure,	stable	-----	15.00	1015	30.45	870	11.10	-----	3
9	-----	250	250	4.75	720	21.60	575	12.50	-----	1
10	200	200	200	5.65	545	16.35	400	6.35	-----	7
11	-----	-----	-----	.00	150	4.50	-----	-----	-----	18
12	300	-----	-----	2.78	270	8.10	125	.97	-----	17
13	200	100	50	3.40	485	14.55	340	6.80	-----	6
14	-----	400	-----	4.80	430	12.90	285	3.75	-----	12
15	-----	-----	300	2.10	315	9.45	170	3.00	-----	13
16	200	100	-----	3.05	455	13.65	310	6.25	-----	8
17	-----	-----	-----	.00	145	4.35	-----	-----	-----	19
18	200	-----	150	2.90	385	11.55	240	4.30	-----	11
19	-----	200	200	3.80	600	18.00	455	9.85	-----	4
20	100	100	100	2.82	555	16.65	410	9.48	-----	5
21	10 2-horse loads manure,	stable	-----	7.50	805	24.15	660	12.30	-----	2
22	500 N. C. Ammoniated Fertilizer, [Phosphate not soluble by laboratory method]	-----	-----	5.00	390	11.70	245	2.35	-----	15

Deductions from the results:

1. Soil was uniform and proved quite responsive to applications.
2. Cotton-seed meal and kainit, in combination, gave best results.
3. Cotton-seed meal alone proved unremunerative, unlike results at nearly every locality.
4. Stable manure gave largest increased yields, and proved quite remunerative.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY R. D. LUNCEFORD, SMITHFIELD, JOHNSTON COUNTY, N. C.

Character of Land:—Level and uniform, sandy loam, well drained. In cotton previous year without manure; yield about 400 pounds in seed, per acre.

FIELD NOTES:—Instructions fully carried out, except that instead of a vacant row a six foot space was left between plots. Seed, "Peterkin," raised at home. Planted April 30th; 17th, harrowed and replanted; 27th, hoed. Heavy rain soon after planting retarded growth. Cold nights about middle of May also damaged crops. Think 10th of May is early enough to plant cotton in this section. June 7th, plowed and hoed. Cotton all dead except bud leaf; 21st, plowed and hoed; crop greatly improved from last working. Opinion is that fertilizers would be of more advantage if applied on 1st or 2d working instead of before planting. Excess of rain for last week caused damage, as did also the cold weather previous to the rain. Lice have damaged the stand also; "most uneven crop ever cultivated." July 7th, plowed; 10th, hoed; 24th, plowed. Convinced that cotton-seed meal alone is the manure for such seasons as this, for where this was used alone the crop has kept green all summer. General condition bad; much damaged by rain. Land full of water—think it will cause crop to shed its fruit; bottom leaves are dropping. Condition very bad, almost a failure; have offered half to have it gathered.

PER ONE ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	600	\$ 18.00	383	\$ 7.80	\$-----	2
2	-----	-----	-----	.00	220	6.60	-----	-----	-----	14
3	300	150	70	5.07	500	15.00	283	3.43	-----	4
4	-----	500	-----	6.00	500	15.00	283	2.50	-----	5
5	-----	-----	400	2.80	380	11.40	163	2.10	-----	6
6	300	200	-----	5.18	400	12.00	183	.32	-----	10
7	300	-----	200	4.18	280	8.40	63	-----	2.28	19
8	20 2-horse loads manure,	-----	stable	15.00	760	22.80	543	1.30	-----	8
9	-----	250	250	4.75	280	8.40	63	-----	2.85	20
10	200	200	200	5.65	520	15.60	303	3.45	-----	3
11	-----	-----	-----	.00	380	11.40	-----	-----	-----	13
12	300	-----	-----	2.78	360	10.80	143	1.52	-----	7
13	200	100	50	3.40	400	12.00	183	2.10	-----	6
14	-----	400	-----	4.80	380	11.40	163	.10	-----	11
15	-----	-----	300	2.10	220	6.60	3	-----	2.00	18
16	200	100	-----	3.05	320	9.60	103	.05	-----	12
17	-----	-----	-----	.00	50	1.50	-----	-----	-----	15
18	200	-----	150	2.90	180	5.40	*37	-----	4.00	21
19	-----	200	200	3.80	280	8.40	63	-----	1.90	17
20	100	100	100	2.82	280	8.40	63	-----	.92	16
21	10 2-horse loads manure,	-----	stable	7.50	1240	37.20	1023	23.20	-----	1
22	500 N.C. Ammoniated Fertilizer, [Phosphate not soluble by laboratory method]	-----	-----	5.00	400	12.00	183	.50	-----	9

*Decreased yield.

Deductions from the results:

1. Stable manure gave greatly increased yields over unfertilized plots, the smaller application proving more remunerative.
2. N. C. Ammoniated Fertilizer increased yield more than the corresponding meal and kainit application, but not as much as complete fertilizer of No. 3.
3. Acid phosphate and cotton-seed meal alone, and in combination, gave good results.
4. Kainit and acid phosphate in combination, proved unremunerative.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY T. J. KING, LOUISBURG, FRANKLIN COUNTY, N. C.

Character of Land:—Gradually sloping; gray, sandy soil; natural drainage. In corn previous year without manure. Previous yield about one and a half barrels per acre.

FIELD NOTES:—Instructions not fully carried out. Length of row seventy yards; width three feet. No vacant row left between plots. Seed grown at home and improved by selection for several years. Planted May 9th. Dry weather retarded germination. Not plowed till June. June 10th, hoed and sided with cultivator; 20th, plowed with sweep. Excessive rains have caused an abundant growth of grass and the crops are deteriorating from lack of cultivation. July, plowed twice with sweeps—first and middle of month; 20th, grassed with hoes. Land is sandy and will not reflect effect of fertilizers. August, commenced opening a little; has suffered materially by the late drouth and a light crop, it seems, must be gathered. *Results*: Land is rolling from No. 10 to No. 22, and, as the cotton suffered more from excessive rains in low places than in high ones, these results cannot be accurate under these conditions. It is plain that complete manure paid best always. Think the yield will reflect average yield in the vicinity.

PER 0.868 ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	80	\$ 2.40	20	\$.-----	\$ 3.10	17.
2	-----	-----	-----	.00	60	1.80	-----	-----	-----	7
3	300	150	70	5.07	445	13.35	385	6.48	-----	1
4	-----	500	-----	6.00	313	9.39	253	1.59	-----	4
5	-----	-----	400	2.80	65	1.95	5	-----	2.65	16
6	300	200	-----	5.18	270	8.10	210	1.12	-----	6
7	300	-----	200	4.18	125	3.75	65	-----	2.23	14
8	20 2-horse loads stable manure,			15.00	340	10.20	280	-----	6.60	19
9	-----	250	250	4.75	185	5.55	175	-----	1.00	11
10	200	200	200	5.65	300	9.00	240	1.55	-----	5
12	300	-----	-----	2.78	70	2.10	10	-----	2.48	15
13	200	100	50	3.40	243	7.29	183	2.09	-----	3
14	-----	400	-----	4.80	220	6.60	160	-----	-----	-----
15	-----	-----	300	2.10	82	2.46	22	-----	1.44	12
16	200	100	-----	3.05	141	4.23	81	-----	.62	9
18	200	-----	150	2.90	145	4.35	85	-----	.35	8
19	-----	200	200	3.80	164	4.92	104	-----	.68	10
20	100	100	100	2.82	230	6.90	170	2.28	-----	2
21	10 2-horse loads stable manure,			7.50	201	6.03	141	-----	3.27	18
22	500 N.C. Ammoniated Fertilizer, [Phosphate not soluble by laboratory method]			5.00	165	4.95	105	-----	1.85	13

Deductions from the results:

1. The complete fertilizer of Nos. 3 and 13 gives best results.
2. Acid phosphate and kainit alone, and combined, increased yield but slightly, and were unremunerative.
3. N. C. Ammoniated Fertilizer increased the yield slightly, but not as great as the complete fertilizer.
4. Stable manure failed to give an increase sufficient to be remunerative.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY C. N. ALLEN, AUBURN, WAKE COUNTY, N. C.

Character of Land:—Gradually sloping and well drained; soil, loamy. In cotton previous year, with compost of cotton-seed, stable manure and scrapings. Yield 1,000 to 1,200 pounds.

FIELD NOTES:—Instructions fully carried out. Additional plots planted and fertilized with bone phosphate and N. C. Lime Phosphate. Seed raised at home. Planted April 22d. May 14th, harrowed; 23d, swept; 31st, chopped. Cold rains during May injured the sprouting crop. No good stand till last of May. June 7th, swept with 12-inch sweeps; 21st, swept with 16-inch sweeps. July 6th, chopped second time; 20th, swept with 20-inch sweeps; 25th, swept with 24-inch sweeps. Kainit plots show yellow; cotton-seed meal plots, green. September: weed is finest where lime and bone phosphate are used (also where cotton-seed meal is used alone); there is virtue in them for *something*, but bone phosphate is a failure for cotton. Cotton-seed meal and lime phosphate will show up better in later reports.

PER ONE ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70.	990	\$ 29.70	285	\$ 4.85	-----	1
2	-----	-----	-----	.00	740	22.20	-----	-----	-----	14
3	300	150	70	5.07	1020	30.60	315	4.38	-----	2
4	-----	500	-----	6.00	990	29.70	285	2.55	-----	8
5	-----	-----	400	2.80	800	24.00	95	.05	-----	13
6	300	200	-----	5.18	1010	30.30	305	3.97	-----	3
7	300	-----	200	4.18	930	27.90	225	2.57	-----	7
8	40 2 horse loads stable manure,	-----	-----	30.00	1200	36.00	495	-----	15.15	27
9	-----	250	250	4.75	810	24.30	105	-----	1.60	20
10	200	200	200	5.65	1020	30.60	315	3.80	-----	4
11	320	160	-----	4.88	990	29.70	285	3.67	-----	5
12	300	-----	-----	2.78	930	27.90	225	3.97	-----	3
13	200	100	50	3.40	880	26.40	175	1.85	-----	11
14	-----	400	-----	4.80	930	27.90	225	1.95	-----	9
15	-----	-----	300	2.10	760	22.80	*55	-----	.45	18
16	200	100	-----	3.05	900	27.00	195	2.80	-----	6
17	-----	-----	-----	.00	670	20.10	-----	-----	-----	15
18	200	-----	150	2.90	800	24.00	95	-----	.05	16
19	-----	200	200	3.80	720	21.60	*15	-----	3.35	25
20	100	100	100	2.82	730	21.90	25	-----	2.07	21
21	20 2-horse loads stable manure,	-----	-----	15.00	1220	36.60	515	.45	-----	12
22	500 N. C. Ammoniated Phosphate, [Phosphate not soluble by laboratory methods.]	-----	-----	5.00	780	23.40	*75	-----	2.75	23
23	300	300	-----	6.37	980	29.40	275	1.88	-----	10
24	L. P. 694	200	-----	5.18	860	25.80	155	-----	.53	19
25	L. P. 925	-----	-----	3.70	820	24.60	115	-----	.25	17
26	B. P. 592	-----	-----	3.70	610	18.30	*95	-----	6.55	26
27	B. P. 444	200	-----	5.18	780	23.40	75	-----	2.92	24
28	B. P. 300	-----	300	3.97	650	19.50	*55	-----	2.32	22

*Decreased yield.

B. P.—Bone Phosphate. L. P.—Lime Phosphate.

Deductions from the results:

1. Acid phosphate and cotton-seed meal alone, and combined, proved profitable applications.

2. Kainit alone, and in single combination, proved unremunerative.

3. N. C. Ammoniated Fertilizer did not increase yield and was not remunerative.

4. Lime phosphate increased the yield but slightly, and was unremunerative, nor did the bone phosphate prove so. (See note.)

NOTE.—The bone phosphate and lime phosphate are natural products and are ground by the N. C. Phosphate Company from their mines at Castle Haynes, N. C. The lime phosphate was purchased at the factory at Raleigh for \$8.00 per ton, the bone phosphate at \$12.50 per ton. The former contained 14.39 per cent. insoluble phosphate of lime and 58.32 per cent. carbonate of lime; the latter contained 36.15 per cent. of phosphate, and 26.52 per cent. of carbonate of lime. The term "bone" phosphate is an erroneous one, as it contains no bone. The test of these products alone, in this way, without previous composting, is hardly fair to them, as they tend to become more soluble by the action of organic constituents in composting. There is no doubt but that the action of these applications would be of value after the first year, and by the aid of composting material and other organic matters would become more soluble on exposure. The presence of the carbonate of lime would more quickly dissolve the insoluble constituents of the fertilizer as well as the soil ingredients. The applications were made on the basis of equal cost as the corresponding application of acid phosphate.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY W. E. ARDREY, PINEVILLE, MECKLENBURG COUNTY, N. C.

Character of Land.—Sandy, level and uniform soil. In wheat previous year without manure. Had been planted in cotton with a yield of 800 pounds in the seed.

FIELD NOTES :—Rows $3\frac{1}{2}$ feet apart; no vacant row left between plots. Planted April 23d. Seed, "Welborn" from U. S. Agricultural Department. May 10th, barred off; 18th, hoed. Dry weather affected the stand, but the condition is healthy. June, plowed twice and hoed once during this month. July 1st, plowed; 15th, plowed; 25th, hoed. Wet weather causes large stalk. Condition very promising.

PER SEVEN-EIGHTH ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	260	\$ 7.80	10	\$-----	\$ 3.40	21
2	-----	-----	-----	.00	240	7.20	-----	-----	-----	20
3	300	150	70	5.07	560	16.80	310	4.23	-----	13
4	400 lbs.	soluble	guano,	5.40	660	19.80	410	6.90	-----	9
5	-----	-----	400	2.80	480	14.40	230	4.10	-----	14
6	300	200	-----	5.18	640	19.20	390	6.52	-----	10
7	300	-----	200	4.18	560	16.80	310	5.12	-----	11
8	20 2-horse loads	stable	-----	15.00	800	24.00	550	1.50	-----	17
9	-----	250	250	4.75	700	21.00	450	8.75	-----	4
10	200	200	200	5.65	720	21.60	470	8.45	-----	5
12	300	-----	-----	2.78	420	12.60	170	2.32	-----	15
13	-----	-----	-----	.00	260	7.80	-----	-----	-----	19
14	-----	400	-----	4.80	420	12.60	170	.30	-----	18
15	-----	-----	300	2.10	380	11.40	130	1.80	-----	16
16	200	100	-----	3.05	500	15.00	250	4.45	-----	12
17	300 lbs.	soluble	guano,	4.05	620	18.60	370	7.05	-----	8
18	200	-----	150	2.90	600	18.00	350	7.60	-----	7
19	-----	200	200	3.80	760	22.80	510	11.50	-----	3
20	100	100	100	2.82	760	22.80	510	12.48	-----	2
21	10 2-horse loads	stable	-----	7.50	760	22.80	510	7.80	-----	6
22	500 N.C. Ammoniated Fertilizer,	-----	-----	5.00	880	26.40	630	13.90	-----	1
	[Phosphate not soluble by laboratory methods.]	-----	-----							

Deductions from the results :

1. Soil responded well to fertilizing applications, but appears to be not uniform.
2. N. C. Ammoniated Fertilizer gave the largest yield, and proved very remunerative. This result appears to be enhanced by the possible greater richness of this portion of the field, as adjoining plots show undue increase over corresponding applications.
3. Acid phosphate, either alone or in single combination, proved a poor application.
4. Cotton-seed meal and kainit separately, yielded poor; but combined, the result was good.

FIELD EXPERIMENTS WITH COTTON.

CONDUCTED BY H. C. DUNN, CLEAR CREEK, CABARRUS COUNTY, N. C.

Character of Land.—Rolling; soil nearly uniform; good gravelly and clay loam. In cotton previous year, with compost and stable manure in hill.

FIELD NOTES.—Instructions carried out as nearly as possible. Seed, ordinary, home-raised. Planted May 4th. Hoed twice and harrowed once during May. Slightly injured by frost. Weather cold and dry throughout May, causing some of the crops to die. Cotton in this section is generally not good, more than half a stand on all fertilized plots. June 7th, plowed; 13th, hoed and chopped; 16th, plowed and hoed; 25th and 26th, broke out middle and hoed, chopping out to a stand. Crop very much behind. Hot and dry to 15th. Irregular and slow of growth on account of drouth and insects during the first half of the month. Better condition at last of month. July 7th, hoed and plowed; 24th, laid crop by, it having been hoed and plowed thoroughly. Crop fruiting nicely. General condition good. August, crops fruiting fairly, weather favorable, except in promoting growth of grass. September, rains did much damage. Laid by in fair condition. Grass probably affected yield. Condition of crop not so good as promised.

PER ONE ACRE.

[Net gain and net loss show comparison with average of three unfertilized plots, after subtracting cost of application.]

Number.	APPLICATION IN POUNDS.			Cost.	YIELD.		RESULTS.			Rank.
	Acid Phosphate.	C. S. Meal.	Kainit.		Seed Cotton, Pounds.	Value.	Increased Yield, Pounds.	Net Gain.	Net Loss.	
1	400	-----	-----	\$ 3.70	380	\$ 11.40	320	\$ 5.90	\$-----	2
2	-----	-----	-----	.00	50	1.50	-----	-----	-----	12
3	300	150	70	5.07	310	9.30	250	2.43	-----	5
4	-----	500	-----	6.00	290	8.70	230	.90	-----	8
5	-----	-----	400	2.80	120	3.60	60	-----	1.00	15
6	300	200	-----	5.18	280	8.40	220	1.42	-----	6
7	300	-----	200	4.18	290	8.70	230	2.72	-----	4
8	20 2-horse loads manure,	-----	stable	15.00	150	4.50	90	-----	12.30	21
9	-----	250	250	4.75	90	2.70	30	-----	3.85	18
10	200	200	200	5.65	170	5.10	110	-----	2.35	16
11	-----	-----	-----	.00	20	.60	-----	-----	-----	13
12	300	-----	-----	2.78	170	5.10	110	.52	-----	10
13	200	100	50	3.40	195	5.85	135	.65	-----	9
14	-----	400	-----	4.80	40	1.20	*20	-----	5.40	19
15	-----	-----	300	2.10	20	.60	*40	-----	2.70	17
16	200	100	-----	3.05	390	11.70	330	6.85	-----	1
17	-----	-----	-----	.00	110	3.30	-----	-----	-----	11
18	200	-----	150	2.90	340	10.20	280	5.50	-----	3
19	-----	200	200	3.80	230	6.90	170	1.30	-----	7
20	100	100	100	2.82	150	4.50	90	-----	.12	14
21	10 2-horse loads manure,	-----	stable	7.50	100	3.00	40	-----	6.30	20

*Decreased yield.

Deductions from the results:

1. Stable manure increased yield but slightly.
2. Acid phosphate alone, and in combination with kainit and meal, yielded well and proved remunerative.
3. Complete fertilizer of Nos. 3 and 13 gave good results.
4. Cotton-seed meal did not prove a remunerative application.

SUMMARY OF RESULTS OF EXPERIMENTS WITH COTTON,
SEASON OF 1889.

In the annexed table is given a summary of results of experiments with cotton, wherein the heavy type expresses the gain in money value, due to the increased yield on the fertilized plots after the cost of the application is subtracted, as compared with the value of the average yield of three unfertilized plots. The ordinary type gives the net loss in money value as compared with the average of three unfertilized plots.

The comparison can only be made on a basis of equal applications, and not on the basis of the same quantity of land. Owing to the different strengths of the various soils, the distance between rows was changed so as to conform to the land. The quantity of land is, therefore, variable, but is expressed in each case in the appropriate columns.

The following deductions from these results can safely be made. It will be remembered that no safe permanent deductions can now be reached, for successive seasons may vary somewhat the results recorded for this year. It will be remembered, also, that the season was unusually an unfavorable one, for cotton especially. In many of the Eastern counties the wet weather of the growing season, and the partial drouth and early frost in ripening season, was peculiarly destructive to the cotton crop. These facts must be considered when comparing the results at the different localities:

1. Applications of fertilizing material, notwithstanding the wet season and other difficulties, were profitable with but few exceptions.

2. Acid phosphate (furnishing available phosphoric acid) has, alone, proved profitable in a majority of cases, which agrees with the result of last year.

3. Cotton-seed meal (furnishing nitrogen, or its equivalent in ammonia), alone, has proved remunerative in both large and small applications. This ingredient has continued to show excellent results when used alone, and verifies the favorable impression made last year. It will be noted that the constituents of this application, existing as organic vegetable compounds, decompose somewhat slowly and so become taken up by the plant at different stages of growth. The wet season seems to increase the favorable action of this application.

4. The experience of kainit (furnishing potash) this year has been the same as last, and verifies the estimate placed upon it at that time. It has proved unprofitable. The wetness of the growing season has increased this result; owing to its ready solubility it has been readily leached away from the roots of the plant. This action has resulted so unfavorably in some cases as to injure the growth of the cotton and to cause a decreased yield, compared with unfertilized plots.

5. Stable manure has proved a beneficial application. Twenty 2-horse loads per acre have increased the yield materially; but, considering the cost, the smaller application of ten 2-horse loads per acre is more remunerative.

6. The new fertilizer, composed of undissolved phosphate mixed with ammonia and potash ingredients, and sold in 1889 as the N. C. Ammoniated Fertilizer by the N. C. Phosphate Co. of Raleigh, N. C., has in a majority of cases yielded a material increase over unfertilized plots, and has proved in these cases slightly remunerative. This increase, however, does not appear to be any greater than the corresponding yield from the application of ammonia and potash materials (cotton-seed meal and kainit) without the addition of the phosphatic materials. There is one exception (in Mecklenburg Co.) to this conclusion, however, where this application has proved to be more remunerative than any other. It seems that this is due to a local cause, probably the greater richness of that portion of the field (see page 68), for the adjoining plots show yields much larger than on similar plots with larger applications.

Comparing the N. C. Ammoniated Fertilizer with a similar application of ammonia, potash and *soluble* phosphoric acid (Nos. 3 and 13), it will be readily noted that the result, with equal values, is much more favorable with the *acid* phosphate, ammonia and potash, than the *undissolved* phosphate, ammonia and potash. Experience of this season would indicate that, with the same amount of money, it would be best to use the acid phosphate instead of the undissolved phosphate, which is not available by laboratory methods. It should be especially mentioned, however, that it is not unlikely that the action of this latter form of phosphate will become more effective and useful as it remains in the soil, and thus will become beneficial as a permanent improver of the soil. This would be more than ever the case if it had been previously composted with stable manure, or if applied to soils containing much organic matter.

7. The conclusion as to what mixture is preferable, is precisely the same as that of 1888. So much is this the case that the words written then, apply with equal force now: "After stable manure, the best application for this season for the average soil appears to be a combination of the three ingredients: available phosphoric acid, nitrogen (or ammonia), and potash. The best proportion of these ingredients was 200 pounds acid phosphate, 100 pounds cotton-seed meal, and 50 pounds kainit, to the acre of average soil. Where the land is poor, this application per acre might well be increased in the same proportion. This mixture yields on an analysis 7.17 per cent. available phosphoric acid, 2.49 per cent. nitrogen, and 2.24 per cent. of potash. It (together with No. 3) more nearly corresponds with the average grade of commercial fertilizer than any other mixture used. The result of the season of 1888, therefore, does not alter our preconceived ideas of the proportion of the various ingre-

dients in a fertilizing application for cotton." The ingredients for 1889 are the same as for 1888, and the analysis of the mixture on Nos. 3 and 13 for 1889 is not materially changed. In some localities the result did not appear to be changed by omitting the kainit from the mixture. It would not be safe to do this, however, unless it is known positively that the soil does not greatly need potash.

8. The results so far recorded are for specific character of soils; and the deductions made are, consequently, for the average of the soils embraced in these experiments. It will be seen that the deductions may not be applicable to any class of soil. With our present knowledge, however, the special mixtures recommended will be more suitable to the average soil than any other mixture of which we have recorded results.

SUMMARY OF RESULTS OF EXPERIMENTS WITH COTTON, 1889.

[Giving net money value of yield from applications (after cost of the application is subtracted) as compared with average of three unfertilized plots; heavy type showing net gain over average of unfertilized plots; ordinary type net loss.]

Number.	APPLICATION IN POUNDS.			Cost of Application.	Cabarrus County. Good Gravelly and Clay Loam Soil. Nearly Uniform.	Franklin County. Gray, Sandy Soil. Per .868 Acre.	Harnett County. Light, Sandy Loam Soil, of Uniform Character. Per $\frac{1}{4}$ Acre.	Hertford County. Sandy Soil. Per $\frac{1}{16}$ Acre.	Johnston County. Sandy Loam Soil. Per Acre.	Mecklenburg County. Sandy and Uniform Soil. Per $\frac{3}{8}$ Acre.	Wake County. Loamy Soil. Per Acre.	Washington County. Medium Stiff Soil. Per $\frac{3}{8}$ Acre.	Wayne County. Sandy Loam with Clay Sub Soil. Per $\frac{3}{8}$ Acre.
	Acid Phosphate.	C. S. Meal.	Kainit.										
1	400			\$ 3.70	\$ 5.90	\$ 3.10	\$ 1.55	\$ 1.40	\$ 7.80	\$ 3.40	\$ 4.85	\$ 1.70	\$ 1.90
2					2.43	6.48	4.38	3.33	3.43	4.23	4.38	1.87	6.05
3	300	150	70	5.07	.90	1.59	.30	4.20	2.50		2.55	3.20	4.20
4		500		6.00	1.00	2.65	.25	.55	2.10	4.10	.05	.80	2.90
5			400	2.80	1.42	1.12	2.47	2.32	.32	6.52	3.97	1.98	6.82
6	300	200		5.18	2.72	2.23	4.67	.73	2.28	5.12	2.57	.98	2.12
7	300		200	4.18	12.30	6.60	11.10		1.30	1.50	.45	5.80	
8	20 2-horse loads stable manure,			15.00	3.85	1.00	12.50	1.15	3.85	8.75	1.60		1.85
9	250	250	250	4.75	2.35	1.55	6.35	2.75	3.45	8.45	3.80	1.45	1.85
10	200	200	200	5.65									
11					.52	2.48	.97		1.52	2.32	3.97	.78	.22
12	300			2.78	.65	2.09	6.80		2.10		1.85	.20	4.70
13	200	100	50	3.40	5.40		3.75		.10	.30	1.95	1.40	.60
14		400		4.80	2.70	1.44	3.00		2.00	1.80	.45	.90	3.60
15			300	2.10	6.85	.62	6.25		.05	4.45	2.80	.15	.85
16	200	100		3.05									
17													
18	200		150	2.90	5.50	.35	4.30		4.00	7.60	.05	1.70	1.60
19		200	200	3.80	1.30	.68	9.85		1.90	11.50	3.35	.60	2.80
20	100	100	100	2.82	.12	2.28	9.48		.92	12.48	2.07	.38	3.18
21	10 2 horse loads stable manure,			7.50	6.30	3.27	12.30		23.20	7.80		4.30	
22	500 N. C. Ammoniated Fertilizer			5.00		1.85	2.35		.50	13.90	2.75	1.80	2.20
23	[Phosphate not available by laboratory methods.]												

BOTANICAL DIVISION.

REPORT OF THE BOTANIST.

GERALD MCCARTHY.

During the year 1889 the botanical work of the Station has included—

1. The identification of a large number of native grasses, weeds and other plants, for citizens of the State, and the supplying of information concerning the economic value of the same.
2. Supplying information as to the value of different genera and species of cultivated grasses with formulas for mixing grass and clover seeds suitable for different soils and purposes.
3. Study of the behavior of the different grasses and clovers under trial at the Experiment Farm, and the accumulation of data for preparing a practical hand-book of grass culture for North Carolina farmers.
4. Study of the noxious weeds of the farm.
5. Continuation of the work of testing the seeds sold in North Carolina in relation to their power of sprouting and freedom from impurities and adulterations.
6. Collection of data for establishing a Laboratory standard of quality for field and garden seeds.
7. Field trials of new forage and fiber plants.
8. Miscellaneous microscopical work.

THE ECONOMIC VALUE OF INDIGENOUS WILD PLANTS.

The indigenous wild grasses and sedges of North Carolina are all of more or less value as food for stock, but being chiefly annuals are not desirable to have upon a cultivated farm. Many weeds known to be entirely worthless have been sent to the Station under the impression that they possessed rare medicinal virtues. Several wild plants, more or less common in woods and wet meadows in different parts of the State, have been sent to the Station with the information that hogs and negroes had been killed by eating them. Among these were the Poison Hemlock, *Cicuta maculata*, and the Stink-horn, *Clathrus Culumnaris*.

It is very desirable that farmers should learn the names and character of all the weeds infesting their fields, so that they might be able to act intelligently in reducing the numbers of these pests, and to detect the presence of new-comers. New weeds, if taken in hand while their habitat is still circumscribed, may be easily eradicated, while if left to themselves for a few years they may become so firmly established as to make it almost impossible to exterminate them.

THE NECESSITY OF SELECTING GRASSES SUITABLE FOR PARTICULAR SOILS.

The increasing interest in the matter of grass and clover culture manifested by the farmers of North Carolina is very gratifying, and promises well for the future prosperity of the agriculture of the State. Most of the soils of the Central and Western districts are well adapted for grass and clovers, and there is no good reason why all the hay needed in the State should not be grown here. But for satisfactory results in laying down land to grass, it is necessary to plant only such species as are suitable for the purpose the farmer has in view, and for his particular kind of soil. Some grasses do well only on very moist soil, others again prefer dry soil. Some prefer heavy clay, and others light loam. Most grasses refuse to grow well under the shade of trees, and such are of little value for lawns, parks or wood pastures. A few grasses often sown in pasture and meadow mixtures last only a year or two and then die out. Again, many of our best pasture grasses are of little value for mowing, and *vice versa*. In laying down land to grass, all these facts must be considered, and the choice of grasses be made according to the special requirements of each case. For permanent pasture, a large number of different species coming to maturity at different periods will prove most profitable. For mowing, on the other hand, only grasses that ripen at nearly the same time should be sown together. This is a point very often overlooked, and we find such grasses as Orchard grass and Timothy sown together. For these reasons the proper selection of grasses is a matter of great importance, for if unsuitable grasses are sown, the error is irremediable, except by breaking up the land and resowing.

The following are examples of formulas furnished to farmers during the year. The best quality or "fancy" seed were recommended to be used in all cases:

For Permanent Pasture—Rich, Moist, Loamy Soil. For one acre :

NAME OF GRASS.	Per cent. of herbage given.	Quantity of seed to use.
Tall Fescue	20	12 pounds.
Red-top	10	2½ " "
Meadow Foxtail	10	3½ " "
Perennial Rye grass	10	6½ " "
Orchard grass	10	4½ " "
Kentucky Blue grass	10	2½ " "
Fiorin	5	1½ " "
Perennial Sweet Vernal	5	2 " "
Fowl Meadow grass	5	1½ " "
Alsike clover	10	1½ " "
White clover	5	½ " "

For Permanent Pasture—Heavy Dry Soil. For one acre :

NAME OF GRASS.	Per cent. of herbage.	Quantity of seed to use.
Red Fescue	20	8 pounds.
Orchard grass	20	10 "
Crested Dogtail	10	3 $\frac{1}{4}$ "
Perennial Rye grass	10	6 $\frac{1}{4}$ "
Tall Oat grass	10	9 "
Kentucky Blue grass	10	2 $\frac{1}{2}$ "
Perennial Sweet Vernal	5	2 "
Perennial Red clover	10	3 "
White clover	5	$\frac{1}{2}$ "

For Permanent Meadow—Light or Medium Upland. For one acre :

NAME OF GRASS.	Per cent. of herbage.	Quantity of seed to be sown.
Orchard grass	30	12 pounds.
Meadow Foxtail	10	4 "
Tall Oat grass	30	29 "
Tall Fescue	10	7 "
Perennial Rye grass	10	7 "
Red clover	10	3 "

For Permanent Meadow—Alluvial Soil. For one acre :

NAME OF GRASS.	Per cent. of herbage.	Quantity of seed to use.
Timothy	40	8 pounds.
Red-top	30	6 "
Fowl Meadow grass	20	6 "
Alsike clover	10	1 $\frac{1}{2}$ "

THE GRASS GARDEN.

In the fall of 1888, forty-six different kinds of grasses and clovers were sown, each on a separate plot, at the Experiment Farm for the purpose of studying their behavior under similar circumstances. The soil used was a rather poor clay loam, underlaid at 8 to 10 inches by heavy red clay. The seeds were sown on October 7. The weather throughout the winter months was about of average quality for this latitude. The mean temperature for the four months—

November, December, January and February—being 44.3° F., and the minimum 13° F. The total precipitation for the same period was 15.57 inches.

A majority of the species sown failed to germinate, or germinated so feebly as to be easily overpowered by weeds and crab grass. Among the species which grew with considerable vigor were the following:

Meadow Fescue—Fine stand; strong grower, very promising.

Tall Fescue—Good stand; plants stouter than meadow fescue, but growth slower.

Crested Dogstail—A good stand, but gradually deteriorated, and was a failure by March 1. Rather tender.

Orchard Grass—Excellent stand; strong grower—vigor about equal to meadow fescue.

Tall Oat Grass—Good stand. Except Italian Rye grass, this is the most vigorous grower in the garden.

Perennial Rye Grass—Good stand; vigorous grower.

Italian Rye Grass—Excellent stand; most vigorous grower in the garden.

Annual Sweet Vernal Grass—Stand poor; growth very slow and patchy.

Perennial Sweet Vernal Grass—Stand very poor; growth slower than the annual variety. Grows in patches.

Timothy Grass—Good stand; grew finely at first, but later deteriorated.

Japan Clover—Grew finely until killed by frost.

Lucerne—Good stand and grew strongly during the winter; growth exceeded only by crimson clover.

White Clover—Fair stand; poor growth.

Perennial Clover—Excellent stand and vigorous growth.

Red Clover—Good stand; continued to grow all winter.

Alsike Clover—Poor stand; weak and straggling growth.

Sanfoin—Fair stand, but soon deteriorated.

The ground upon which these plants grew was not frozen to any appreciable depth during the winter, and most of the plants continued to grow throughout the cold season.

In the spring it was deemed expedient to have the grass plots on a different part of the farm. These fall-sown plots were therefore abandoned, and other plots sown in April. The land used for the spring-sown plots was a poor, sandy loam, underlaid at a depth of 8 to 10 inches by a red clay. It was very deficient in humus. The season proved one of the wettest ever known. On September 3d, the following notes were made of the appearance of the different plots:

Alsike Clover—Total failure.

Crimson Clover—Fair stand; mown once.

White Clover—Fair stand; not mown or grazed.

Red Clover—Fair stand; not mown or grazed.

Pea Vine or Perennial Clover—Fair stand; not mown or grazed.

Yellow Suckling Clover—Total failure.

Japan Clover—Splendid stand; growth very thick, about 10 inches high. Seed was blown from this plot upon a roadside adjoining, where it readily took root.

Black Medic—Total failure.

Lucerne—Fair stand; mown once.

Bokhara Clover—Fair stand; not mown.

Sanfoin—Nearly total failure.

Honey or Bee Clover—Total failure.

Serradella—Good stand; plants grew about 15 inches high; mowed once.

Golden Millet—Good stand; plants grew 2 feet; mown in August.

Pearl Millet—Good stand; plants grew 4 feet.

Hungarian Millet—Good stand; plants grew $1\frac{1}{2}$ to 2 feet.

Perennial Rye Grass—Failure.

Italian Rye Grass—Failure.

Annual Sweet Vernal Grass—Fair stand; plants about 8 inches high.

Perennial Sweet Vernal Grass—Fair stand; plants about 8 inches high.

Red-top Grass—Good stand; growth upright, about 15 inches.

Piorin Grass—Good stand; growth creeping.

Meadow Fescue—Fair stand; growth about 2 feet.

Tall Fescue—Fair stand; growth about 2 feet.

Sheep's Fescue—Good stand; growth about 6 inches; tufted.

Johnson Grass—Very poor stand; plants grew about 3 feet high and seeded.

Teosinte—Fine stand; plants grew about 5 feet high, but bore no flowers or seed.

Besides the above, there were plots of all the popular Northern and English grasses; but all were failures, owing, probably, to the pertinacious intrusion of crab grass, *Panicum sanguinale*, and its congener, *Panicum proliferum*. The soil upon which these plots were placed was scarcely rich enough for grass, and was too full of crab grass seed. The seed used was furnished by Peter Henderson & Co., and sprouting tests showed it to be all of good to superior quality.

The growing of different grasses in small contiguous plots is in no sense a fair test of their real or relative value, except for the soil or field in question. Most of our best agricultural grasses belong to different genera and grow naturally upon very different soils. Thus, orchard grass, timothy, meadow foxtail and others do well only upon rich, moist clay loams, while tall oat grass and most of the fescues prefer light and rather dry soil. Alsike clover requires a different soil from that preferred by red clover. Hence "grass gardens" have chiefly a local value. They serve also as object

lessons to visitors, but general conclusions cannot be safely drawn from the results of such plot growth.

EXPERIMENTS WITH PERMANENT PASTURE GRASSES.

There are at present on the Experiment Farm, 24 $\frac{1}{10}$ acre plots, which were laid down as examples of "permanent pasture" in September, 1886. The mixture of seeds used by Mr. Milton Whitney, then Superintendent of the farm, was the following:

Red clover, 10 pounds; orchard grass, 10 pounds; tall oat grass, 10 pounds; red-top, 5 pounds; Italian rye grass, 5 pounds; meadow fescue, 5 pounds; annual sweet vernal grass, 3 pounds; Kentucky blue grass, 5 pounds; yellow oat grass, 3 pounds. Total per acre, 56 pounds.

The same mixture and quantity of seed was used upon all the plots, but the plots were arranged in 12 pairs, each pair receiving a different treatment as to fertilizer. The original intention was to repeat the fertilization annually, but this plan was interrupted owing to cessation of farm operations in 1888. No manure of any kind has been put upon the plots since they were laid down in 1886, and the plots have been mowed instead of grazed.

The following notes show the treatment originally given to each plot; the condition of the herbage May 7, and July 13, 1889; and the yield at each cutting, and for the season. The best plots were, after the last cutting, grazed to a limited extent, but no estimate can be made as to the forage thus utilized. The figures showing the comparative abundance of the different plants on the plots are estimates only, as the plants grew in bunches and patches, so that the analysis of anything less than the entire plot would be wholly untrustworthy.

The plots, $\frac{1}{10}$ acre each, are contiguous and so arranged that there are four plots in a row in one direction, and six plots in the other. Each plot is separated from the others by a walk three feet wide, which is kept plowed. The duplicate plots are as distant from each other as the case admits.

PLOT 40.—*Stable manure 150 cart-loads per acre, in September, 1886.*

May 7, 1889. Herbage abundant. Red clover 18 inches high, in bloom, 50 per cent. of herbage. Orchard grass 36 inches high, in bloom, 40 per cent. Tall oat grass 38 to 40 inches high, partly in bloom, 10 per. cent. Plot mowed May 20. Yield of air-dry hay, at rate 1,760 pounds per acre.

July 13. Herbage abundant. Red clover, in bloom, 50 per cent. Red-top, over-ripe, 30 per cent. Tall oat grass, not in bloom, 24 inches high, 20 per cent. Mowed July 17. Yield of air-dry hay 1,480 pounds per acre. Total yield 3,340 pounds per acre.

PLOT 41.—*Bone meal, 1000 pounds, kainit 600 pounds per acre.*

May 7. Plot thin and weedy. Red clover, 40 per cent. Orchard grass, 20 per cent. Tall oat grass, 20 per cent. Sweet vernal grass, 10 per cent. Weeds, chiefly plantain, 10 per cent. Mowed May 20. Yield, air-dry hay, 1,480 pounds per acre.

July 13. Herbage scant. Red clover, 50 per cent. Red-top, 30 per cent. Tall oat, 20 per cent. Some weeds. Mowed July 17. Yield, air-dry hay, 880 pounds per acre. Total yield, 2,360 pounds per acre.

PLOT 42.—*Lime, 2,000 pounds per acre.*

May 7. Herbage very scant. Red clover, 12 inches high, in bloom, 30 per cent. Tall oat grass, 30 inches high, 50 per cent. Orchard grass, 24 inches, 15 per cent. Sweet vernal grass, 10 inches high, 7 per cent. Weeds, chiefly plantain and sheep's sorrel, 8 per cent. Mowed May 20. Yield, air-dry hay, 780 pounds per acre.

July 13. Herbage fair. Red-top, 12 inches high and over-ripe, 50 per cent. Red clover, 30 per cent. Tall oat, 15 per cent. Weeds, chiefly ox-eye daisy, 5 per cent. Mowed July 17. Yield, air-dry hay, 600 pounds per acre. Total yield, 1,380 pounds per acre.

PLOT 43.—*Sub-soiled; stable manure, 150 cart-loads; lime, 2,000 pounds per acre.*

May 7. Herbage luxuriant. Red clover, 18 inches high, in bloom, 50 per cent. Orchard grass, 36 inches high, in bloom, 40 per cent. Tall oat grass, 30 inches high, not in bloom, 10 per cent. Mowed May 20. Yield, air-dry hay, 3,280 pounds per acre.

July 13. Herbage luxuriant. Red clover, 40 per cent. Tall oat grass, 30 per cent. Orchard grass, 25 per cent. Weeds, 5 per cent. Mowed July 17. Yield, air-dry hay, 2,560 pounds per acre. Total yield, 5,840 pounds per acre.

PLOT 44.—*Bone-meal, 1,000 pounds; kainit, 600 pounds; lime, 2,000 pounds per acre.*

May 7. Herbage thin. Red clover, 18 inches high, in bloom, 80 per cent. Orchard grass, 5 per cent. Tall oat, 5 per cent. Broom sedge (*andropogon virginians*) and other weeds, 10 per cent. Mowed May 20. Yield, air-dry hay, 1,520 pounds per acre.

July 13. Herbage fair. Red clover, 15 to 20 inches high, 60 per cent. Red-top, 12 to 15 inches, over-ripe, 30 per cent. Weeds, 10 per cent. Mowed July 17. Yield, air-dry hay, 1,760 pounds per acre. Total yield, 3,280 pounds per acre.

PLOT 45.—*Sub-soiled.*

May 7. Herbage scarce and stunted. Red clover, 12 inches high, in bloom, 70 per cent. Sweet vernal, 8 inches high, 15 per cent. Weeds, 15 per cent. Mowed May 20. Yield, hay, 80 pounds.

July 13. Herbage scarce. Red-top, over-ripe, 80 per cent. Red clover, 10 per cent. Weeds, 10 per cent. Mowed July 17. Yield, hay, 560 pounds per acre. Total yield, 640 pounds per acre.

PLOT 46.—*Phosphate, 2,000 pounds; kainit, 600 pounds per acre.*

May 7. Herbage fair. Red clover, 9 inches high, partly in bloom, 30 per cent. Tall oat grass, 18 inches high, 50 per cent. Orchard grass, 10 per cent. White clover, 5 per cent. Weeds, 5 per cent. Mowed May 20. Yield, hay, 1,440 pounds per acre.

July 13. Herbage scant. Red clover, 50 per cent. Red-top, 30 per cent. Sweet vernal, 10 per cent. Weeds, 10 per cent. Mowed July 17. Yield, hay, 1,000 pounds per acre. Total yield, 2,440 pounds per acre.

PLOT 47.—*Nothing.*

May 7. Herbage very scarce and stunted. Red clover, 8 inches high, 60 per cent. Sweet vernal, 6 inches high, 30 per cent. Weeds, 10 per cent. Mowed May 20. Yield, hay, 800 pounds per acre.

July 13. Plot very bare. Red-top, 60 per cent. Red clover, 30 per cent. Weeds, 10 per cent. Mowed July 17. Yield, hay, 680 pounds per acre. Total yield, 1,480 pounds per acre.

PLOT 48.—*Bone-meal, 1,000 pounds; kainit, 600 pounds; nitrate of soda, 100 pounds per acre.*

May 7. Herbage fairly abundant, but in patches. Tall oat grass, 30 inches high, not in bloom, 50 per cent. Red clover, 18 inches high, not in bloom, 40 per cent. Weeds 10 per cent. A very little orchard grass. Mowed May 20. Yield of hay, 1,480 pounds per acre.

July 13. Herbage fair. Red clover, 60 per cent. Red-top, 30 per cent. Weeds, 10 per cent. Mowed July 17. Yield, hay, 1,360 pounds per acre. Total yield, 2,840 pounds per acre.

PLOT 49.—*Stable manure*. 150 cart-loads per acre.

May 7. Herbage luxuriant. Red clover, 18 inches high, in bloom, 40 per cent. Tall oat grass, 30 inches high, not in bloom, 25 per cent. Orchard grass, 30 inches high, in bloom, 25 per cent. Sweet vernal, 10 inches high, 5 per cent. Weeds, 5 per cent. Mowed May 20. Yield, hay, 2,940 pounds per acre.

July 13. Herbage luxuriant. Red clover, 50 per cent. Tall oat grass 25 per cent. Red-top, 20 per cent. Weeds, 5 per cent. Mowed July 17. Yield, hay, 1,880 pounds per acre. Total yield, 4,820 pounds per acre.

PLOT 50.—*Nothing*.

May 7. Herbage very scarce. Sweet vernal grass, 6 inches high, 30 per cent. Orchard grass, 12 to 15 inches high, 20 per cent. Weeds, 50 per cent. Mowed May 20. Yield, hay, 220 pounds per acre.

July 13. Herbage scant. Red-top grass, 50 per cent. Sweet vernal, 20 per cent. Weeds, 30 per cent. Mowed July 17. Yield, hay, 600 pounds per acre. Total yield, 820 pounds per acre.

PLOT 51.—*Stable manure*. 150 cart-loads; phosphate, 2,000 pounds; kainit 600 pounds per acre.

May 7. Herbage fair, bunchy, with bare interstices. Red clover, 24 inches high, in bloom, 40 per cent. Orchard grass, 36 inches high, 30 per cent. Alsike clover, 14 inches high, in bloom, 10 per cent. Tall oat grass, 5 per cent. Weeds, 5 per cent. Mowed May 20. Yield, hay, 2,400 pounds per acre.

July 13. Herbage fair. Red clover 50 per cent. Red-top, 30 per cent. Alsike clover, 10 per cent. Weeds, 10 per cent. Mowed July 17. Yield, hay, 2,720 pounds per acre. Total yield, 5,120 pounds per acre.

PLOT 52.—*Stable manure*, 150 cart-loads; lime, 2000 pounds per acre.

May 7. Herbage luxuriant and uniform. Red clover, 18 inches high, in bloom, 35 per cent. Orchard grass, 45 inches high, in bloom, 35 per cent. Tall oat grass, 10 per cent. Alsike clover, 12 inches high, in bloom, 10 per cent. Weeds, 10 per cent. Mowed May 20. Yield, hay, 3,320 pounds per acre.

July 13. Herbage luxuriant. Red clover, 20 inches high, 50 per cent. Tall oat grass, in bloom, 36 inches high, 25 per cent. Orchard grass, 18 inches high, 10 per cent. Red-top, 10 per cent. Weeds, 5 per cent. Mowed July 17. Yield, hay, 1,680 pounds per acre. Total yield, 5,000 pounds per acre.

PLOT 53.—*Sub-soiled; stable manure*, 150 cart-loads; lime, 2,000 pounds per acre.

May 7. Herbage very luxuriant. Red clover 18 inches high, in flower, 50 per cent. Orchard grass, 25 per cent. Tall oat grass, 10 per cent. Alsike clover, 10 per cent. Weeds, 5 per cent. Mowed May 20. Yield, hay, 3,700 pounds per acre.

July 13. Herbage very luxuriant. Red clover, 20 inches high, in bloom, 50 per cent. Tall oat grass, 36 inches high, in bloom, 30 per cent. Orchard grass, 24 inches high, 10 per cent. Sweet vernal, 5 per cent. Weeds, 5 per cent. Mowed July 17. Yield, hay, 2,480 pounds per acre. Total yield, 6,180 pounds per acre.

PLOT 54.—*Sub soiled*.

May 7. Herbage scant and stunted. Sweet vernal grass, 50 per cent. Red clover, 20 per cent. Tall oat grass, 10 per cent. Weeds, 20 per cent. Mowed May 20. Yield, 360 pounds per acre.

July 13. Herbage scant. Red clover 30 per cent. Red-top, 50 per cent. Weeds, 20 per cent. Mowed July 17. Yield, 920 pounds per acre. Total yield, 1,280 pounds per acre.

PLOT 55.—*Phosphate*, 2,000 pounds; kainit, 600 pounds per acre.

May 7. Herbage, scant and stunted. Red clover, 11 inches high, 40 per cent. Orchard grass, 30 per cent. Sweet vernal grass, 10 per cent. Weeds, 20 per cent. Mowed May 20. Yield, hay, 1,120 pounds per acre.

July 13. Herbage, scant and stunted. Red clover, 40 per cent. Red-top, 40 per cent. Weeds, 20 per cent. Mowed July 17. Yield, hay, 1,280 pounds per acre. Total yield, 2,400 pounds per acre.

PLOT 56.—*Nothing.*

May 7. Plot nearly bare. Sweet vernal grass, 30 per cent. Orchard grass, 20 per cent. Weeds, chiefly blackberry bushes, plantain and sheep-sorrel, 30 per cent. Mowed May 20. Yield, hay, 440 pounds per acre.

July 13. Plot nearly bare. Red-top, 40 cent. Sweet vernal, 20 per cent. Weeds, 40 per cent. Mowed July 17. Yield, hay, 800 pounds per acre. Total yield, 1,240 pounds per acre.

PLOT 57.—*Stable manure, 150 cart-loads; lime, 2,000 pounds per acre.*

May 7. Herbage luxuriant and uniform. Red clover, 18 inches high, in bloom, 40 per cent. Orchard grass, 48 inches high, in bloom, 40 per cent. Tall oat grass, 30 inches high, 20 per cent. Mowed May 20. Yield, hay, 3,800 pounds per acre.

July 13. Herbage luxuriant. Red clover, 40 per cent. Tall oat grass, 30 per cent. Orchard grass, 10 per cent. Red-top, 10 per cent. Weeds, 10 per cent. Mowed July 17. Yield, 2,640 pounds per acre. Total yield, 6,440 pounds per acre.

PLOT 58.—*Nothing.*

May 7. Herbage, scant and stunted. Orchard grass, 30 per cent. Sweet vernal grass, 20 per cent. Weeds, 50 per cent. Mowed May 20. Yield, hay, 460 pounds per acre.

July 13. Herbage, scant and stunted. Red-top, 40 per cent. Weeds, 60 per cent. Mowed July 17. Yield, hay, 720 pounds per acre. Total yield, 1,180 pounds per acre.

PLOT 59.—*Bone-meal, 1,000 pounds; kainit, 600 pounds; lime, 2,000 pounds per acre.*

May 7. Herbage good. Red clover, 18 inches high, in bloom, 50 per cent. Tall oat grass, 30 inches high, 30 per cent. Orchard grass, 5 per cent. Sweet vernal 5 per cent. Weeds, 10 per cent. Mowed May 20. Yield, hay, 2,600 pounds per acre.

July 13. Herbage good. Red clover, 40 per cent. Tall oat grass 40 per cent. Red-top, 15 per cent. Weeds, 5 per cent. Mowed July 17. Yield, hay, 1,960 pounds per acre. Total yield, 4,560 pounds per acre.

PLOT 60.—*Stable manure, 150 cart-loads; phosphate, 2,000 pounds; kainit, 600 pounds per acre.*

May 7. Herbage, luxuriant. Red clover, 18 inches high, in bloom, 50 per cent. Orchard grass, 30 inches high, in bloom, 30 per cent. Sweet vernal, 12 inches high, 5 per cent. Tall oat, 30 inches high, 10 per cent. Weeds, 5 per cent. Mowed May 20. Yield, hay, 3,660 pounds per acre.

July 13. Herbage luxuriant. Red clover, 50 per cent. Tall oat grass, 40 per cent. Weeds, chiefly plantain and horse-nettle, 10 per cent. Mowed July 17. Yield, hay, 3,120 pounds per acre. Total yield, 6,780 pounds per acre.

PLOT 61.—*Lime, 2,000 pounds per acre.*

May 7. Herbage, very scant and stunted. Red clover, 8 inches high, in bloom, 30 per cent. Sweet vernal grass, 6 inches high, 20 per cent. Weeds—ox-eye daisy, plantain and rag-weed—50 per cent. Mowed May 20. Yield, hay, 500 pounds per acre.

July 13. Herbage, very scant. Red-top grass, 40 per cent. Red clover, 20 per cent. Weeds, 60 per cent. Mowed July 17. Yield, hay, 800 pounds per acre. Total yield, 1,300 pounds per acre.

PLOT 62.—*Bone-meal, 2,000 pounds; kainit, 600 pounds per acre.*

May 7. Herbage, scant and stunted. Sweet vernal grass, 10 inches high, 50 per cent. Orchard grass, 18 inches high, 20 per cent. Red clover, 10 inches high, 10 per cent. Alsike clover, 10 inches high, 5 per cent. Rabbit's foot clover (*T. arvense*), 5 per cent. Weeds, 10 per cent. Mowed May 20. Yield, hay, 680 pounds per acre.

July 13. Herbage, scant. Red-top grass, 50 per cent. Red clover 10 per cent. Rabbit's foot clover, 10 per cent. Weeds, 10 per cent. Mowed July 17. Yield, hay, 1,320 pounds per acre. Total yield, 2,000 pounds per acre.

PLOT 63.—*Bone-meal*, 1,000 pounds; *kainit*, 600 pounds; *nitrate of soda*, 100 pounds per acre.

May 7. Herbage, scant and stunted. Red clover, 15 inches high, in bloom, 50 per cent. Orchard grass, 12 inches high, 30 per cent. Sweet vernal, 10 per cent. Weeds, 10 per cent. Mowed May 20. Yield, 1,040 pounds per acre.

July 13. Plot nearly bare. Red-top grass, 40 per cent. Red clover, 20 per cent. Weeds, 40 per cent. Mowed July 17. Yield, hay, 1,280 pounds per acre. Total yield, 2,360 pounds per acre.

DISCUSSION.—In comparing the herbage of the different plots, we find that in nearly all cases red clover is the predominating constituent. Of the true grasses, orchard grass takes the lead on the plots receiving stable manure, while on the mineral plots tall oat grass is the most abundant grass. Several of the original constituents of the mixture have disappeared entirely. These are meadow fescue, Italian rye grass, yellow oat grass and Kentucky blue grass. Whether it was that the seeds of these grasses failed to germinate, or after germinating were crowded out by their more aggressive competitors, cannot now be ascertained. The latter is the most likely, for the seeding was excessive. In several of the plots we find a considerable amount of alsike clover, which was not a constituent of the original mixture. The alsike seed probably came as an impurity in the red clover.

The following table groups the various pairs of plots and gives the total yield of each plot and the average for each pair for 1887 and 1889. No record was kept during 1888:

Plot No.	Treatment.	Yield in 1887, air-dry hay.		Yield in 1889, air-dry hay.		Plot No.
		Each Plot	Av. for pair.	Each Plot.	Av. for pair.	
56	Nothing	303 lbs.	} 151 lbs.	1240 lbs.	} 1210 lbs.	56
58	Nothing	0 "		1180 "		58
47	Nothing	840 "	} 354 "	1480 "	} 1650 "	47
50	Nothing	272 "		820 "		50
45	Sub-soiled	11 "	} 137 "	640 "	} 960 "	45
54	Sub-soiled	263 "		1280 "		54
42	Lime	624 "	} ----	1380 "	} 1340 "	42
61	Lime	Lost.		1300 "		61
40	Stable manure	1539 "	} 2358 "	3240 "	} 4030 "	40
49	Stable manure	3177 "		4820 "		49
52	Stable manure, lime	1710 "	} ----	5080 "	} 5760 "	52
57	Stable manure, lime	Lost.		6440 "		57
43	Stable mauure, lime, sub-soiled	2463 "	} 2659 "	5840 "	} 6010 "	43
53	Stable manure, lime, sub-soiled	2855 "		6180 "		53
51	Stable manure, phos., kainit ..	Lost.	} ----	5120 "	} 5959 "	51
60	Stable manure, phos., kainit	2624 "		6780 "		60
46	Phosphate, kainit	538 "	} 501 "	2440 "	} 2420 "	46
55	Phosphate, kainit	468 "		2400 "		55
41	Bone, kainit	1294 "	} 1152 "	2360 "	} 2180 "	41
62	Bone, kainit	1010 "		2000 "		62
44	Bone, kainit, lime	515 "	} 629 "	3280 "	} 3920 "	44
59	Bone, kainit, lime	744 "		4560 "		59
48	Bone, kainit, nitrate of soda	Lost.	} ----	2840 "	} 2600 "	48
63	Bone, kainit, nitrate of soda	1286 "		2260 "		63

Average yield of "Nothing" Plots in 1889.....1430 lbs. air-dry hay per acre.

Average yield of stable manure plots, 1889.....4030 lbs. air-dry hay per acre.

Average yield of mineral plots, 1889.....2780 lbs. air dry hay per acre.

Average yield of stable man. and min. plots, '89...5960 lbs. air-dry hay per acre.

The former Superintendent of the farm, Prof. Milton Whitney, who laid down these plots, in his report for 1887 states that the object was to determine the best treatment to prepare worn-out land for the establishment of a permanent grass sod. As the answer was wanted as soon as possible and decisive as to the question asked, the fertilizers were in all cases used in maximum quantities, and the seeding extra heavy. It was the original intention to repeat the dressing of fertilizer annually, but this has not been done.

So far as the main question is concerned, the plots have given a sufficiently definite answer. The following facts are well brought out by the experiment:

1. The treatment most profitable was the application of stable manure. This soil, like most of the worn soils of central Carolina, is very deficient in organic matter, and hence the good effect of the stable manure. Next to the stable manure, bone meal gives the best results.

2. Sub-soiling is not profitable on such land.

3. It is a waste of effort to attempt to grow good grasses on such soil without manuring heavily. Though the "Nothing" plots are credited with a considerable yield of produce, in fact this produce consisted chiefly of weeds, and was in no case worth mowing.

4. The heavy application of mineral fertilizers alone to such land does not pay..

5. Excessive seeding, such as was given in this case, is not profitable.

LUCERNE.

The $\frac{1}{10}$ acre plot of lucerne sown on the Experiment Farm in 1887 continues to give satisfaction, and demonstrates the great value of this plant for our State. The soil of the Experiment Farm is a stiff, badly-drained, red clay, not well adapted to lucerne, yet the plant does very well. The almost daily rains of the past season kept the soil constantly saturated, and the plants showed the effect by turning yellow and dropping their leaves.

This plot is sown in drills 18 inches apart. During the season of 1889, the plot was hoed only once, and became foul with crab grass towards the end. It received no fertilizer. Was mown three times. First cutting, May 11, yielded of air-dry hay at rate of 2,020 pounds per acre. Second cutting, June 18, yielded of air-dry hay at rate of 1,520 pounds per acre. Third cutting, August 9, yielded of air-dry hay at rate of 1,360 pounds per acre. Total yield 4,900 pounds per acre. A fourth cutting might have been taken October 1st, but was not. An analysis of hay from this plot, made by Mr. B. W. Kilgore of the Station, is given on the following page, together with similar analyses of lucerne hay made elsewhere.

A smaller plot of lucerne sown broadcast at the Experiment Farm in April did considerably better than contiguous plots of red, white and alsike clovers.

In March, 1889, the Station sent to co-operating farmers in sixty-five counties of the State one pound packages of lucerne seed for a field test. The season proved very wet, and all the experimenters seem to have become discouraged and early gave the experiment up as a failure. This was an unfortunate and wholly premature judgment. Lucerne is a perennial, and though it may not, under unfavorable conditions, make a good showing the first season, it is likely to hold

the ground, and should the ensuing spring prove favorable it may surprise many who have given it up as lost, by shooting up before any other sown crop.

In the fall the Station again distributed 55 packages of lucerne seed for further trial and comparison with the spring-sown seed. We look for better results from this trial, and trust our co-operating experimenters will not be so easily discouraged.

COMPOSITION OF LUCERNE HAY.

GROWN IN	ANALYZED BY	Moisture.	Pure ash.	Ether extract— (fat).	Albuminoids— (proteins).	Nitrogen—free extract.	Crude fiber.
North Carolina..	N. C. Experiment Station.....	12.42	6.96	2.18	15.28	38.77	29.42
New York	N. Y. Experiment Station	15.02	6.69	2.26	13.81	34.97	27.28
New Jersey	N. J. Experiment Station.....	6.78	7.10	2.05	17.04	37.11	30.34
Colorado	Colorado Experiment Station..	9.37	11.68	3.34	15.22	45.74	14.65
Germany	Prof. J. Kuhn.....	16.10	6.00	2.50	14.40	27.90	33.00
Germany	Prof. E. Wolff.....	16.00	6.20	2.50	14.40	27.90	33.00

THE NOXIOUS WEEDS OF AGRICULTURE.

Among the most active and injurious enemies of the farmer are the various unwelcome plants or "weeds" which intrude into his fields and choke out the useful plants he has sowed. It is not rare during seasons of extreme wetness to have whole fields overrun and the crop ruined by these pests. Under any circumstances, the necessity of combatting these pests is a heavy charge upon the profit of the farm. The question is often asked, "Is there no way by which these undesirable, useless and injurious plants may be exterminated at once and forever?" The extermination of weeds is scarcely possible, but by the careful following out of a judicious system of cultivation any field may be practically freed from weeds in a few years, and once free from weeds, may be kept so at much less expense than is usually bestowed upon the mere repression of the pests. A bulletin on this subject has been prepared and will be published early in 1890.

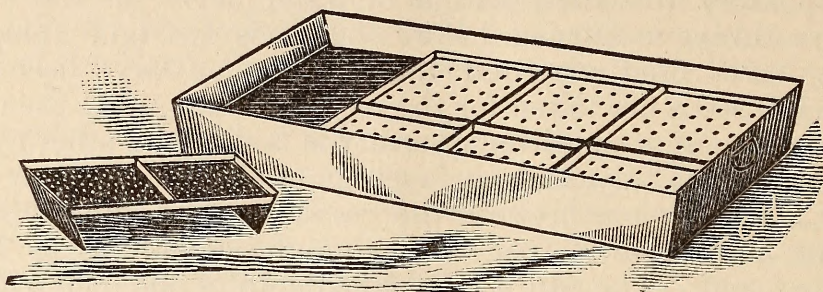
THE QUALITY OF SEEDS SOLD IN NORTH CAROLINA.

The work of testing the quality of seeds sold by local dealers in different towns in the State, began last year, has been vigorously prosecuted during the past year. Two bulletins on the subject have been published. In all, about 1,500 samples were examined at the Station for impurities and adulteration, and tested as to their capa-

bility of sprouting. In addition to the seeds purchased of local dealers, we received a large number of samples directly from wholesale seedsmen in America and Europe, and the testing of these samples furnished a standard by which to judge the quality of the seeds obtained from local dealers. As regards the latter, while a large part of the samples were reasonably free from impurities, and of fair average vitality, in many cases seeds were found on sale, at prices equal to the price of good seed, which our tests showed to be worthless, or worse than worthless. One firm, on being confronted with the results of the test of seeds purchased of them, confessed that the seeds were stale, but claimed that they were sold by mistake. Dealers should not make such mistakes, for the sufferer is in all cases the purchaser, who not only pays his money for worthless seed, but loses also his labor, the value of the land for the time, the opportunity to make a crop in season and also the fertilizer he may have put upon the land. Farmers and others who use seeds need educating as to the real value and comparative cheapness of high and low-grade seeds. Most of the clover samples purchased of local dealers proved to be of the lowest grade known to the respectable trade, viz: "uncleaned" seed. This quality of seed includes all the weed seeds that have been harvested with it, often as much as one-fifth of the entire weight. Plantain, and hog-weed, and dock seeds are the most common impurities found in uncleaned clover seed, and these plants are very difficult to get rid of when once introduced into a meadow. Clover seed containing much of these weed seeds is not worth sowing, even if it could be had for nothing.

In laying down pasture or meadow lands the best seed should always be used, and it is always in the end the cheapest. The most common fraud perpetrated upon seed purchasers is the palming off upon them of stale seeds. Most of the seed sold in our local markets is of Northern growth, and this, even if of good quality, when originally received, is likely to deteriorate so rapidly as to be nearly worthless if kept over until the succeeding season. This is especially true of the finer grass seeds and of lucerne. The seed trade would be greatly benefited by the adoption, in this country of the guarantee system, very generally adopted in England, Germany and Switzerland. By this system the seed dealer guarantees his seeds to have a specified percentage of purity and of vitality. The purchaser is at liberty to verify the quality of the seed by submitting a sample to the analysis of a competent botanist, and if not found as guaranteed the seller is bound to make a commensurate reduction in price or take back the seed and pay cost of carriage. Purchasers and honest seed dealers are thus protected from the imposition and unfair competition of unscrupulous dealers. If seed purchasers insist upon getting seeds of guaranteed quality, and are willing to pay a fair price for the same, the seedsmen will, without doubt, undertake to supply the demand, but so long as purchasers

of water below the trays, ease of regulating the degree of moisture, and of removing sprouted seeds. The seeds are supplied with sufficient air while being protected from light.



THE NORTH CAROLINA SEED TESTING PAN.

FIELD TESTS OF NEW FODDER AND FIBER PLANTS.

In March, 1889, the Station sent to 24 co-operating experimenters located 12 in the Eastern, 8 in the Middle, and 4 in the Western districts of the State, samples of seeds of several new and promising forage and fiber plants with brief directions for cultivation and uniform blank forms for recording the details and results of the tests. To each was sent seeds of the following: Kaffir corn, Egyptian rice-corn, Brazilian flour-corn, improved evergreen broom-corn, dwarf broom-corn, early amber sorghum, early orange sorghum, early rural branching sorghum, pearl millet, prolific tree bean, soja bean, Canada white peas, Canada blue peas, mammoth Russian sun-flower, flax, silver ramie. Eight only of the 24 experimenters sent in reports. Of these one was from the Eastern, three from the Middle and four from the Western district. The season proved one of the wettest ever known, and crops in all the districts, but especially in the Eastern, were uncommonly short. Hence, the failure of so many to report and the somewhat discouraging reports of the few who have reported. These reports must not be taken as decisive as to the value of any of these crops. They merely indicate the comparative worth of the different crops under the circumstances. Had the year been normally dry, or as dry as it was wet, the reports might have been different. In most cases the land used for the tests was very poor, and the fertilizer insufficient to give a good yield of any crop. Under the circumstances the reports indicate that several of these crops will prove valuable acquisitions to the agriculture of the State. These experiments will be continued until a fair and full test of the merits of the different plants is had in different parts of the State, and under different conditions of weather.

In the following reports the soil and fertilizer used by each experimenter is the same for all of the crops, and is therefore described only once:

KAFFIR CORN.

A variety of non-saccharine sorghum. It is recommended by seedsmen as nearly drought-proof and capable of growing on land too sandy for Indian corn. It sprouts from the butt when cut, and if planted early and cut when in flower, a second or even third crop of fodder can be secured, or the second crop will produce seed. It is said to make good ensilage. Largely grown in the Gulf States.

T. B. LINDSAY, *Douglas, Rockingham County*:

Land level sandy loam, porous in texture and very poor. Last crop on land was rye, which yielded at the rate of six bushels per acre. Land has received no manure for last three years.

Area of experimental plot $\frac{1}{50}$ acre. Planted April 30th, in drills four feet apart, plants eight to twelve inches in drill. Average height of mature stalks five feet. Yield of fodder, compared with Indian corn, about 90 per cent. Fodder much liked by stock. I think Indian corn is more profitable.

ALEX. McIVER, *Pittsboro, Chatham County*:

Land gray, gravelly loam, of fair quality. Last crop on land was Indian corn. Used no manure on experimental plots.

Area of plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart. Average height of mature stalks, six feet. Yield of fodder, compared with Indian corn, 80 per cent. Stock eat it greedily. It is a valuable crop.

J. C. WILLIAMS, *Winslow, Harnett County*:

Land light, sandy loam, manured with stable manure broadcasted. Last crop on land was Indian corn, yielding at the rate of fifteen bushels per acre. Experimental plots $\frac{1}{50}$ acre. Planted Kaffir corn April 29th in drills four feet apart, plants two feet apart in drills. Average height of mature stalks, seven feet. Yield of fodder, compared with Indian corn, 110 to 115 per cent. Yield of cleaned seed at the rate of $31\frac{1}{2}$ bushels per acre. Plant is a vigorous grower and yields a large amount of fodder. Fodder much liked by stock. Kaffir corn will give more grain on some land than Indian corn, and the Kaffir corn makes better bread. It is a valuable plant.

J. C. COOPER, *Dobson, Stokes County*:

I am very proud of the Kaffir corn and will save my entire crop for seed. I planted too late this year for best results. Every farmer should grow a patch of Kaffir corn.

W. E. ARDREY, *Pineville, Mecklenburg County*:

Land level sandy loam. Planted last year in cotton manured in drill with compost. Yield, 1,000 pounds seed cotton per acre. Experimental plot $\frac{1}{50}$ acre. Kaffir corn planted April 29th in drills four feet apart, plants six inches apart in drill. Average height of stalks, five feet. Yield of fodder, compared with Indian corn, 80 per cent. Yield of cleaned seed at rate of 28 bushels per acre. Fodder very fine and well liked by stock.

H. C. DUNN, *Clear Creek, Cabarrus County*:

Land an old field, cold gravelly soil, with clay sub-soil. First taken in last year and planted in cotton with compost in drills. Experimental plots $\frac{1}{50}$ acre. Kaffir corn planted April 30th in drills four feet apart, plants eight to ten inches in drill. Planted too late, and none of the plants matured. Weather very unfavorable. Not a fair trial.

DISCUSSION.—A comparison of the different reports indicates the superiority of Kaffir corn over Indian corn on light, dry soil of average fertility. On very poor, cold or wet soil it is a comparative

failure. Had the season been as droughty as seasons sometimes are in this State, the advantages of Kaffir corn over Indian corn would have been more manifest. Altogether this seems a valuable crop for home consumption. Eventually, when its excellent edible qualities become known, there will be a sufficient market for all the grain that can be grown. By planting as early as the danger of frost will permit, and cutting the first growth for fodder as soon as it comes into flower, two crops—one for fodder and one for seed—can be secured annually. The proper distance for drills seems to be about four feet on good soil. The plants should not be closer than 12 inches in the drill.

EGYPTIAN RICE CORN.

A non-saccharine variety of sorghum. Valued for green fodder. Said to bear droughts better than Indian corn, and, on fair soil, to yield forty bushels cleaned seed per acre. Prefers light soil.

T. B. LINDSAY :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart with plants eight to twelve inches apart in drills. Growth strong. Average height of matured stalks, six feet. Yield of fodder, compared with Indian corn, 90 per cent. Yield of cleaned seed at rate of 32 bushels per acre. Fodder well liked by stock. It is a pretty good fodder plant.

ALEX. McIVER :—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart, plants eight to twelve inches apart in drill. Growth vigorous. Average height of mature plants, six and a half feet. Yield of fodder, as compared with Indian corn, 80 per cent. Did not save seed. Stock eat the fodder greedily. It is a valuable plant.

J. C. WILLIAMS :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart, plants two feet apart in drills. Growth thrifty. Average height of stalks, six and a half feet. Yield of fodder, compared with Indian corn, 90 to 100 per cent. Yield of cleaned seed at rate of 21 bushels per acre. Stock seem to relish the fodder about as well as Kaffir corn, but the latter is the more profitable.

J. C. COOPER :—My Egyptian corn did tolerably well. Needs further trial.

W. E. ARDREY :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart, plants six inches apart in drills. Growth vigorous. Average height of mature stalks, six feet. Yield of fodder, compared with Indian corn, 85 per cent. Yield of grain at rate of 18 bushels per acre. Fodder relished by stock about the same as Indian corn. It is a good crop.

DISCUSSION.—Egyptian corn is certainly a very promising crop, and well worth trial by farmers who have light soil. As compared with Kaffir corn, Egyptian corn seems rather less profitable, but a further trial might reverse the position. Probably best to plant in drills $3\frac{1}{2}$ to 4 feet apart, and thin to a stand of 12 to 15 inches in drill.

BRAZILIAN FLOUR CORN.

Brazilian corn is a variety of Indian corn or maize from South America. Too tender to succeed north of Philadelphia. Rather

extravagant claims are made for this plant by seedsmen. It is said to yield more fodder than any other plant, and twice as much grain as common field corn. The meal or flour is whiter than wheat flour, and is claimed to make better bread, while yielding much more than wheat does. Plant stools immensely, thereby affording a great deal of foliage. The stalks bear several ears each.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart, chopped to stand of twelve inches in drill. Average height of stalks, eight feet. Yield of fodder, as compared with Indian corn, 80 per cent. Grain not saved. Stock eat it well. It is a somewhat good forage plant.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart. Chopped to stand of three feet in drill. Average height of stalks, nine feet. Yield of fodder, as compared with Indian corn, 100 per cent. The suckers were removed from all but two hills and these two hills showed that the removal of the suckers was a mistake and decreased the possible yield of fodder. Yield of grain at the rate of 50 bushels ears per acre. Green fodder greedily eaten by stock. Have not tried the dry fodder. I think the crop will pay to cultivate.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills three and four feet. Average height of stalks, four feet. Got a very poor stand and the trial not a fair one. Stock eat the green fodder very well. Do not consider it a safe crop.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart. Chopped to stand of twenty-four to thirty inches in drill. Average height of stalks, two to four feet. Yield of grain and of fodder light. Did not try it on stock. It may be of value.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart with plants twenty-four inches apart in drill. Growth thrifty. Average height of mature stalks, three and a half feet. Yield of fodder, compared with Indian corn, 100 per cent. Yield of grain at rate of 25 bushels ears per acre. Fodder and grain greedily eaten by stock. A good forage plant, but rather small yielder of grain.

DISCUSSION.—The tests of Brazilian Flour corn do not seem to bear out the claims of seedsmen. Still, the reports indicate that this is a valuable plant. Most of our experimenters seem to have planted too thinly. Probably $3\frac{1}{2}$ feet between drills and 15 inches apart in drill will be thin enough to plant. When grain is the chief object, the suckers should be removed, but when planted for fodder alone, these may be left to grow. This plant seems to require a stronger and richer soil than any of the sorghum forage plants. We have no reports as to the edible quality of the grain.

EVERGREEN BROOM-CORN.

This is the well known standard broom-corn plant, so extensively grown in the Western States. The seed is said to be equal to corn for fattening stock.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart and chopped to stand of eight to ten inches in drill. Average height of stalks, six feet, very slender. Quality of brush good. Did not try it as fodder. We can grow good broom-corn but know nothing about making brooms.

failure. Had the season been as droughty as seasons sometimes are in this State, the advantages of Kaffir corn over Indian corn would have been more manifest. Altogether this seems a valuable crop for home consumption. Eventually, when its excellent edible qualities become known, there will be a sufficient market for all the grain that can be grown. By planting as early as the danger of frost will permit, and cutting the first growth for fodder as soon as it comes into flower, two crops—one for fodder and one for seed—can be secured annually. The proper distance for drills seems to be about four feet on good soil. The plants should not be closer than 12 inches in the drill.

EGYPTIAN RICE CORN.

A non-saccharine variety of sorghum. Valued for green fodder. Said to bear droughts better than Indian corn, and, on fair soil, to yield forty bushels cleaned seed per acre. Prefers light soil.

T. B. LINDSAY :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart with plants eight to twelve inches apart in drills. Growth strong. Average height of matured stalks, six feet. Yield of fodder, compared with Indian corn, 90 per cent. Yield of cleaned seed at rate of 32 bushels per acre. Fodder well liked by stock. It is a pretty good fodder plant.

ALEX. McIVER :—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart, plants eight to twelve inches apart in drill. Growth vigorous. Average height of mature plants, six and a half feet. Yield of fodder, as compared with Indian corn, 80 per cent. Did not save seed. Stock eat the fodder greedily. It is a valuable plant.

J. C. WILLIAMS :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart, plants two feet apart in drills. Growth thrifty. Average height of stalks, six and a half feet. Yield of fodder, compared with Indian corn, 90 to 100 per cent. Yield of cleaned seed at rate of 21 bushels per acre. Stock seem to relish the fodder about as well as Kaffir corn, but the latter is the more profitable.

J. C. COOPER :—My Egyptian corn did tolerably well. Needs further trial.

W. E. ARDREY :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart, plants six inches apart in drills. Growth vigorous. Average height of mature stalks, six feet. Yield of fodder, compared with Indian corn, 85 per cent. Yield of grain at rate of 18 bushels per acre. Fodder relished by stock about the same as Indian corn. It is a good crop.

DISCUSSION.—Egyptian corn is certainly a very promising crop, and well worth trial by farmers who have light soil. As compared with Kaffir corn, Egyptian corn seems rather less profitable, but a further trial might reverse the position. Probably best to plant in drills $3\frac{1}{2}$ to 4 feet apart, and thin to a stand of 12 to 15 inches in drill.

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ALEX. McIVER :—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart, chopped to stand of twelve inches in drill. Average height of stalks, eight feet. Yield of fodder, as compared with Indian corn, 80 per cent. Grain not saved. Stock eat it well. It is a somewhat good forage plant.

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H. C. DUNN :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills three and four feet. Average height of stalks, four feet. Got a very poor stand and the trial not a fair one. Stock eat the green fodder very well. Do not consider it a safe crop.

R. G. HAMILTON :—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart. Chopped to stand of twenty-four to thirty inches in drill. Average height of stalks, two to four feet. Yield of grain and of fodder light. Did not try it on stock. It may be of value.

T. B. LINDSAY :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart with plants twenty-four inches apart in drill. Growth thrifty. Average height of mature stalks, three and a half feet. Yield of fodder, compared with Indian corn, 100 per cent. Yield of grain at rate of 25 bushels ears per acre. Fodder and grain greedily eaten by stock. A good forage plant, but rather small yielder of grain.

DISCUSSION.—The tests of Brazilian Flour corn do not seem to bear out the claims of seedsmen. Still, the reports indicate that this is a valuable plant. Most of our experimenters seem to have planted too thinly. Probably $3\frac{1}{2}$ feet between drills and 15 inches apart in drill will be thin enough to plant. When grain is the chief object, the suckers should be removed, but when planted for fodder alone, these may be left to grow. This plant seems to require a stronger and richer soil than any of the sorghum forage plants. We have no reports as to the edible quality of the grain.

EVERGREEN BROOM-CORN.

This is the well known standard broom-corn plant, so extensively grown in the Western States. The seed is said to be equal to corn for fattening stock.

T. B. LINDSAY :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart and chopped to stand of eight to ten inches in drill. Average height of stalks, six feet, very slender. Quality of brush good. Did not try it as fodder. We can grow good broom-corn but know nothing about making brooms.

ALEX McIVER :—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart and chopped to a stand of six inches in drill. Growth slender. Average height, ten feet. Yielded at the rate of six and a quarter tons green fodder per acre. Do not consider it profitable.

J. C. WILLIAMS :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills three feet apart and chopped to stand of eighteen inches in drill. Growth healthy and thrifty. Average height of stalks, thirteen feet to the brush which was turned down. Brush twenty to twenty-four inches long and of good quality. Fodder not very good. Doubt if it would be profitable to grow this crop at present.

W. E. ARDREY :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart and chopped to a stand of six inches in drill. Growth very fine. Average height of stalks, seven feet. Yield at the rate of two hundred pounds brush and six hundred pounds fodder per acre. Fine brooms could have been made from the brush.

H. C. DUNN :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart and chopped to stand of eight inches in drill. Growth v-ry thrifty. Average height of stalks, nine feet. Quality of brush fine, but yield not large. Did not save fodder. Think the plant is hard on the soil and there is no sufficient market for brush.

R. G. HAMILTON :—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart and chopped to a stand of twelve inches in drill. Growth very flourishing. Average height of stalks at maturity, six to eight feet. Quality of brush good. Did not save fodder. The plant is all right. I think good brooms can be made from it if some one will try.

IMPROVED DWARF BROOM-CORN.

This variety of broom-corn is said to make finer brush than the taller variety, but requires more care and skill to handle.

T. B. LINDSAY :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart and chopped to a stand of ten inches in drill. Plant grew short and bunchy. Average height at maturity, four and a half feet. Quality of brush fine. No fodder. I like the brush.

ALEX. McIVER :—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart and chopped to a stand of six inches in drill. Growth tall and slender. Average height at maturity, nine feet. Do not consider it equal to cotton or clover as to profit.

J. C. WILLIAMS :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills three feet apart and thinned to eighteen inches in drill. Growth thrifty. Average height of stalks at maturity, nine feet to brush, which was turned down. Brush twenty to twenty-two inches long. Quality of brush good. Think it might pay to manufacture the brush into brooms, but know little about broom-making.

W. E. ARDREY :—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart and thinned to six inches in drill. Growth very fine. Average height of stalks at maturity, seven feet. Quality of brush fine. Fine brooms could have been made of it.

H. C. DUNN :—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart and thinned to hills of two or three stalks eight inches apart. Growth thrifty. Average height of stalks at maturity, ten feet. Brush was short and bushy. I like the brush, but do not think it would be profitable to grow it here at present.

R. G. HAMILTON :—Plot $\frac{1}{50}$ acre. Planted April 11th in drills three feet apart and thinned to twelve inches in drill. Growth flourishing. Average height of stalks, three to six feet. Quality of brush fine. The brush is all right if some one will manufacture it.

DISCUSSION.—From these reports there is very little doubt but that a good quality of broom-corn can be grown in this State. When cut early, as it should be done for the best quality of brush, the plant is not as hard upon the soil as Indian corn. Broom-corn is, however, a plant that requires the cleanest of cultivation, and involves much handling to get it ready for market. There is, we believe, a broom manufactory at or near Asheville, in this State, but the chief market for Southern grown broom-corn would be Baltimore. The manufacture of brooms is by no means difficult work, and may be easily learned and carried on at home during the winter. A market can always be had for the brooms. The Orange Judd Company, of New York, publish a small but useful handbook, "Broom Corn and Broom-making," which explains the process of broom-making. Price fifty cents.

EARLY AMBER SUGAR CANE.

This is the variety of cane chiefly grown in the West.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart; thinned to six inches in drill. Growth tall and slender. Average height of matured stalks, nine feet. Quality of syrup not tested. Hardly think it would be a profitable crop.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills three feet apart; thinned to twelve inches in drill. Growth thrifty but slender. Average height of mature plant, nine and a half feet. Quality of syrup good, but yield small. Seed is tolerably good feed for stock. Two cuttings—one for fodder and a second for syrup—may be obtained. Yield of seed 850 pounds per acre. Plant not as profitable as other cane.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart and thinned to six inches in drill. Growth very fine. Average height of mature stalks, eight feet. Quality of syrup very fine. Seed liked by stock; it is as good as corn for feed. Think it a profitable crop.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart; fair stand. Growth beautiful and thrifty. Average height of mature stalk, nine feet. Quality of syrup not tested. Yield of seed not estimated. Seed eagerly eaten by stock. Makes best of fodder. A profitable crop.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart; thinned to twelve inches in drill. Growth small. Average height of mature stalks, four to five feet. Quality of syrup not known—plants injured by frost. Seed and fodder well liked by stock. Think it is too small to be profitable.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Growth slender, long jointed. Average height of mature stalks, six feet. Quality of syrup good, but yield small. Yield of seed about 250 pounds per acre. Seed liked by stock, but fodder not so well. It is not a profitable crop.

EARLY ORANGE CANE.

This is a more tender variety of cane than the Early Amber and more adapted to the climate of the Southern States.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Growth tall and inclined to tangle. Average height of mature stalks, seven feet. Quality of syrup very fine. Yield of seed at rate of 400 pounds per acre. Seed and fodder much liked by stock. Can be made a profitable crop.

ALEX. MCIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart; thinned to six inches in drill. Growth vigorous. Average height of mature stalks, nine feet. Quality of syrup not tested. Stock afraid of the fodder. Can be made a profitable crop.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills three feet apart; thinned to eighteen inches in drill. Growth large and healthy. Average height of mature stalks, ten to eleven feet. Quality of syrup fine and yield good. Two crops—one for fodder and one for syrup may be made. Yield of seed at rate of 1,500 pounds per acre. Stock like seed tolerably, but the fodder less. Think it can be made a profitable crop.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart. Growth large and fine but later than early amber. Average height of mature stalks, seven feet. Quality of syrup good. Yield of seed at rate of 1,500 pounds per acre. Stock like both seed and fodder. Can be made a profitable crop.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Good stand, but cut down by chinch bugs; afterward it sprouted from root and grew finely, but was destroyed by frost before maturity. Fodder well liked by stock. Think it is a profitable crop.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart and thinned to twelve inches in drill. Growth, luxuriant. Plants killed by frost before maturity. Fodder well liked by stock. Think it is a profitable crop.

DISCUSSION.—The results of the experiments with sweet sorghums show conclusively that the plant is at home in this State. The comparative test of Early Amber and Early Orange is very strongly in favor of the latter. There have been very great improvements recently made in the art of manufacturing marketable sugar from sorghum juice, and a good quality of sugar could probably be made from North Carolina cane. But while the State consumes hundreds of hogsheads of West India molasses annually, there will be no lack of a market for all the sorghum syrup likely to be offered. Therefore this is one of the most promising crops for North Carolina farmers to take up. When the crushed stalks or *bagasse* is saved and returned to the land, or, better, fed to stock and the manure returned to the soil, sorghum is one of the least exhausting of crops which can be grown. In the way of fertilizer, cane chiefly requires phosphates.

EARLY RURAL BRANCHING SORGHUM.

This is one of the non-saccharine sorghums and is more commonly called millo maize. Growth resembles Kaffir corn, but is said to branch more and afford more fodder. Highly extolled by seedsmen as a forage plant.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Growth upright and stocky. Average height of mature stalks, six to eight feet. Yield of seed at rate of 250 pounds per acre. Seed and fodder well liked by stock. Think it can be made a profitable crop.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart, and thinned to six in drill. Growth vigorous. Average height of mature stalks ten feet. Seed or fodder not offered to stock. Think it is a profitable crop.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th in hills three by two feet. Growth vigorous and healthy. Average height of mature stalks eleven feet. Will yield two crops by cutting the first very early, but second crop will not be so heavy as first. Yield of seed at rate of 1,500 pounds per acre. Seed and fodder well liked by stock. Is a profitable crop.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart. Growth stout but low. Average height of mature stalks six feet. Yield of seed at rate of 1,650 pounds per acre. Seed and fodder well liked by stock. It can be made a profitable crop.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Started off finely, but plants cut down by chinch bugs. Sprouted from root and gave a good crop of fodder, but did not mature. Think it can be made a profitable crop.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart and thinned to twelve inches in drill. Growth luxuriant. Average height of stalks nine feet. Plants killed by frost before maturity. Yield of seed at rate of 1,650 pounds per acre. Seed and fodder well liked by stock. A profitable crop.

DISCUSSION.—Millo maize appears to thrive well wherever tried, and seems to be about as valuable as Kaffir corn. It is claimed to exceed Kaffir corn in the yield of fodder, but falls below it in the yield of grain. The plant is well worthy of more extensive cultivation in this State.

PEARL MILLET.

A large and rather coarse growing grass—very popular for soiling cattle in some parts of the West. Yields enormously on rich soil. Valuable only when fed green. Requires a good moist soil.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Growth bunchy. Average height of mature stalks seven feet. Not relished by stock as well as corn fodder. Think it too coarse.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart. Growth slender, tall and bunchy. Yield of green fodder at rate of 20,100 pounds per acre. Fodder liked by stock. Think it is a good crop.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart. But few plants came up. These grew thriftily and were all preserved for seed. Plant is liked by stock and I think it will pay well to grow it.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills three and a half feet apart. Growth tall and fine. Average height of mature stalks, eight feet. Fodder liked by stock when green. I do not think highly of it.

DISCUSSION.—Most of those to whom pearl millet seed was sent report a total failure, probably on account of improper planting. This plant requires a rich and rather moist soil. It can be cut twice during the season, and is said to make good ensilage. It should be cut when in bloom, as the stalks become hard soon after, and are then nearly uneatable.

PROLIFIC TREE BEAN.

This bean greatly resembles the common navy bean in size, color and edible qualities. Seedsmen claim that it will out-yield the navy bean by 50 per cent. The plant is very stout and holds its pods out of the soil.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Growth upright, bunchy, leafy. Good table bean; tolerably liked by stock. Yield of beans at rate of three bushels per acre. Value compared with common navy bean, seventy-five per cent.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart and thinned to ten inches in drill. Growth luxuriant. Good for table use and for stock. Yield not estimated. Value, compared with common navy bean, eighty per cent.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart. Good for table use and for stock. Value, compared with common navy beans, eighty per cent.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills two feet apart and thinned to fifteen inches in drill. Stand nearly perfect. Growth healthy, but slow owing to drought. Yield of beans eight and a half bushels per acre. Value, compared with common navy bean, eighty per cent. Had a few beans left after sowing plot. These were planted in very fertile garden soil and yielded at the rate of three times as much as the field plot. The vines in garden plot grew tall and fell over, and sticks having been supplied, the plants *climbed* on them. Season bad and trial not satisfactory. Will try them again.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills two feet apart and thinned to fifteen inches in drill. Growth very fine. Desirable for table use. Not tried for stock. Yield of beans at rate of thirteen and one-fourth bushels per acre.

DISCUSSION.—The results of trials of this bean do not seem to justify the claims of seedsmen that it yields so much better than the common navy bean. Beans are a crop that require no nitrogen in fertilizer, but are heavy consumers of phosphates and potash. It is very likely that the soils upon which these trials were made were deficient in these substances, and hence the smallness of yield. The season was very unfavorable for this class of plants. The trials are, therefore, not conclusive and the plant merits further attention. The proper distance for drills seems to be $2\frac{1}{2}$ to 3 feet, with the plants 18 inches apart in drill. Should not be cultivated after blooming.

SOJA BEAN.

This plant has been cultivated in the South for several years, but seems to make small headway in popularity. Introduced from Japan, where it is one of the chief edible crops. Said to make fine soup when properly cooked.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart. Growth upright, leafy. Beans of medium quality. Yield at rate of six bushels per acre. Value, compared with common navy beans, seventy-five per cent. Do not like the beans.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d in drills four feet apart and thinned to ten inches in drills. Growth vigorous. Beans are difficult to cook, but make good soup. Value, compared to common navy beans, ninety per cent. Stock refuse the vines.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in hills eighteen by forty inches. Stand nearly perfect. Growth vigorous, resembling the tree bean, but the pods are fuzzy and contain usually three beans. Yield about nine and a half bushels per acre. Quality of beans not tested on table, but they seem inferior to the tree bean for food. This crop attracted much favorable attention from my neighbors. Many will plant it next season. Have saved my seed and will plant all of them.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three and a half feet apart and thinned to thirteen inches in drill. Growth luxuriant. Yield at rate of six bushels per acre. Quality not tested. Think it a good crop.

DISCUSSION.—All of our reports place the yield of the Soja below that of the common navy bean, but the Soja has the reputation of being much more prolific than the navy bean. It is probable that the unfavorable season diminished the yield and our correspondents have based their comparison upon the yield of navy beans in *good* years. Dr. W. R. Capehart, of Bertie County, is a large grower of Soja beans, and reports the average yield at 35 to 40 bushels per acre, for which there is a ready market at \$2 per bushel. Dr. Capehart finds the vines very good feed, either green, dry or ensilaged. The cultivation of leguminous crops should be encouraged, for the reason that such plants make very nutritious food, are not hard upon the soil, and derive a large portion, if not all, of their nitrogen from the atmosphere. No nitrogen need be supplied in fertilizer for leguminous crops. Beans, however, require an extra quantity of potash and also a good deal of phosphate. They should be planted on light soil and cultivated shallow until they begin to bloom; after that, let them alone until ready to harvest. If vines are cut green for hay, they should be allowed to dry in field for half a day, and then be put up in small cocks and allowed to dry out. They should be handled as little as possible, to prevent waste of leaves. Stock, which at first reject bean vine fodder, generally become very fond of it after they get used to it. Three feet apart is proper distance for drills and 18 inches for plants in drill.

WHITE CANADA FIELD PEAS.

Peas are very largely grown in Canada as a field crop for stock. The fodder is generally liked by cattle and sheep, while the seeds are much esteemed for table use. There are two varieties, the white and the blue pea—the blue pea the heavier yielder, but the white is earlier. Both are very hardy.

J. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th broadcast. Seeding at rate of one and a half bushels per acre. Growth strong and upright. Yield decreased by wet weather. Saved half gallon of seed, which is at the rate of about three bushels per acre. Edible quality of peas very good. Value, compared with cow-peas, about 75 per cent. Do not think it is a profitable crop.

ALEX. McIVER:—Plot $\frac{1}{50}$ acre. Planted May 3d broadcast. Growth small, not worth cutting for fodder. Yield of peas light. Edible quality equal to garden peas. Value, compared with cow-peas, 40 per cent. My plot was planted too late.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th, part drilled, part broadcasted. Crop a total failure. Consider these peas not adapted to our soil nor good for stock.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. My crop planted too late and failed. Think they should be planted very early in drills and cultivated.

BLUE CANADA FIELD PEA.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th broadcast at rate of one and a half bushels per acre. Growth slender and easily laid. Did not save any fodder. Yield diminished by wet weather. Edible quality of peas tolerably good. Value, compared with cow-peas, 70 per cent. Do not consider it a profitable crop.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th broadcast at the rate of one and a half bushels per acre. Growth tolerably thrifty. Crop badly damaged by hares. Did not cut any fodder. Yield of peas at the rate of twelve and a half bushels per acre. Edible quality of peas very good. Value, compared with cow-peas, 100 per cent. or more, if planted at right time. This pea may be planted about Christmas, and not later than February 15th. When so planted they are profitable. The blue pea is later than the white and makes a good succession.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th broadcast. Crop a failure. Do not consider it adapted for our climate.

DISCUSSION.—As a summer crop, the Canada field pea is inferior to the Southern cow pea, but the Canada pea is so hardy it may be planted very early, and will give a crop before the cow pea can be planted. The Canada pea has edible qualities of a high order. This pea should be planted in drills 24 inches apart, with plants 6 to 10 inches apart in drill.

RUSSIAN SUNFLOWER.

The mammoth sunflower is said to have been introduced from Russia. The seeds have become a very popular winter food for poultry and horses. The seed contains a large amount of oil, which give a fine gloss to the feathers of fowls and the hair of horses. It stimulates hens to lay. Plant said to be an enormous yielder of seeds.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills four feet apart; thinned to two and a half or three feet between plants. Growth upright. Average height four feet. Yield of seed at rate of twenty-five bushels per acre. Diameter of largest head eleven inches, or average heads four inches. Poultry do not seem to appreciate it. Don't think much of the plant.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th in hills three by two feet. Growth, luxuriant. Average height, seven feet. Diameter of largest head fourteen inches; of average heads six inches. Yield of seed at rate of sixty-two bushels per acre. Some fowls are very fond of the seed, while others will not eat them. Yield is wonderful, but stock do not seem to relish the seed.

J. C. COOPER:—I am well pleased with the sunflower and will plant all the seed I grow this year.

W. E. ARDREY:—Plot $\frac{1}{50}$ acre. Planted April 29th in drills four feet apart and thinned to six inches in drill. Growth very fine. Average height of mature stalks, six feet. Diameter of largest head, eight inches; of smallest head five inches. Yield of seed at rate of one hundred bushels per acre. A good plant for poultry.

H. C. DUNN:—Plot $\frac{1}{50}$ acre. Planted April 30th in drills three and a half feet apart. Got only half stand. Growth not very strong. Diameter of largest head twelve inches; of smallest head seven inches. Average height of mature stalks, eight feet. Yield of seed at rate of twenty-five bushels per acre. Sparrows took about half the seed. Good for poultry, especially during moulting season. Every farmer should raise all he can of it.

R. G. HAMILTON:—Plot $\frac{1}{50}$ acre. Planted May 11th in drills three feet apart and fifteen inches apart in drill. Growth, luxuriant. Average height of mature plant, seven feet. Diameter of largest head, fourteen inches; of average head, nine inches. Yield of seed at rate of sixty-two bushels per acre. Seed good for poultry. A profitable crop if we had a market for the seed.

DISCUSSION.—From these reports it would seem that this is a valuable plant for farmers who keep poultry. Horses and hogs can be taught to eat the seed. The cultivation is simple and the yield very large. The plant is not hard upon the soil. A half acre or so of this plant will cost little trouble, and yield a very valuable winter food for poultry and other stock. This is a plant for marshy localities. It is worthy of further trial.

FLAX.

Flax was formerly a more important crop than cotton in North Carolina, but for many years its cultivation has almost ceased. There is not much demand for the fibre in this country, but the plant is still largely cultivated for its seed in the West.

T. B. LINDSAY:—Plot $\frac{1}{50}$ acre. Planted broadcast April 30th. Growth slender. Average height two feet. Yield of seed at rate of twelve quarts per acre. Plot hand weeded once. Did not do well.

J. C. WILLIAMS:—Plot $\frac{1}{50}$ acre. Planted April 29th; broadcasted at rate of twelve quarts per acre. Growth fine. Average height for mature stalks twenty-three inches. Yield of seed at rate of six bushels per acre. Crop was hand-weeded twice.

DISCUSSION.—Flax, as a crop, is valuable only for its oil and cake, there being no market for the fiber or straw. This plant thrives best on a very rich and moist soil and would probably do well on the alluvial bottoms of the Roanoke and other rivers which are liable to overflow, and therefore unsuitable for cotton.

SILVER RAMIE.

Ramie is a plant that promises to become exceedingly valuable, if suitable machinery can be devised for working up the fiber. All

such machines yet tried have failed to give satisfaction, and there is no market for the ramie plant at present. All our experimenters report a total failure of the seed to sprout. The seed being of low vitality, was probably unable to force its way through the hard crust formed on the surface of the soil by the heavy rains.

DONATIONS—SEEDS, 1889.

The following donations were received during 1889, and are here thankfully acknowledged:

- Delano Moore, Presque Isle, Me., one package rutabaga seed.
- James Vick, Rochester, N. Y., half ounce Pyrethrum seed; half ounce Opium poppy seed.
- E. J. McGehee, Pinckneyville, Miss., one package Southern Hope cotton seed.
- D. H. Talbot, Sioux City, Iowa, one sack black barley.
- Symmes Hay Cap. Co., Concord, N. H., one model of hay and grain cap.
- Northrup, Braslin & Co., Minneapolis, Minn., one package "Minnesota King" corn; several packages of vegetable seeds.
- Jeff. D. Welborn, New Boston, Texas, four pounds Welborn's Pet cotton seed.
- Peter Henderson & Co., New York, N. Y., twelve packages grass and clover seeds; one package Pyrethrum seed; 120 packages flower seeds.
- Mandeville, King & Co., Rochester, N. Y., two boxes flower seeds.
- Jas. Carter & Co., London, England, fifteen packages "Elephant" rutabaga seed.
- Jas. Hunter, Chester, England, twelve packages grass and clover seeds.
- Fratelli Ingegnoli, Milan, Italy, one package Giant white clover seed.
- Lecoq & Co., Darmstadt, Germany, twenty-four packages grass and clover seeds.
- T. W. Wood & Sons, Richmond, Va., fifty-eight packages flower seeds.
- Henry Nungesser, New York, fifteen packages grass and clover seeds.
- U. S. Department Agriculture, sixty-eight packages seeds.
- Jas. B. Alcott, Connecticut, two sods of grass; one package grass seed.

HORTICULTURAL DIVISION.

REPORT OF THE HORTICULTURIST.

W. F. MASSEY.

As a great deal of interest is being manifested in the purposes and plans of the Horticultural Division of the North Carolina Agriculture Experiment Station, a brief statement of its aims may not come amiss at this time. But little has been attempted in a systematic way in horticultural investigations at this Station heretofore, and with a view to put the work here on a corresponding footing with the practical work in agriculture, the Board, in December last, appointed the writer Horticulturist of the Station. It is proposed during this year to devote our main attention, aside from starting new plantations of fruits, to comparative tests of such vegetables as are commonly grown South for Northern shipment.

With this purpose in view, we have begun to make tests of peas, cabbage, tomatoes, Irish and sweet potatoes, and garden corn. In the line of corn for table use, it has long been known that little success has been had in growing the early varieties of sugar corn, so popular at the North, in the South. One great difficulty, we apprehend, aside from insect pests, has been the constant dependence of our growers upon seed of these varieties grown at the North, and the neglect to produce an acclimated variety. Corn, more than any of our cereals, dislikes a sudden change of latitude, either southward or northward, and the best success for grain crops is always had by persistent selection in the latitude and soil where the crop is to be grown. But in table corn there has been a continuous neglect to establish a variety accustomed to our soil and climate, and growers annually buy Northern seed, and are annually disappointed. The earliest corn grown North, which does reasonably well here, is the Early Adams or Burlington. This is not a sweet sort, and is only desirable for its earliness. But even the Adams can be vastly improved by continuous selection in the locality where the crop is to be grown. This has been abundantly proved by the market gardeners in Patapsco Neck, near Baltimore, Md., where an improved strain of the Adams has long been grown under the name of Neck corn. It is not only improved in robustness of plant and length of ear, but is actually earlier, as I have proved, than the Northern Adams. This shows that it is possible to produce an acclimated sort that will suit any particular locality better than corn brought from a distance. With the object in view of producing such a variety for our use here, we have procured seed of a number of early Northern varieties of corn. These will be planted and allowed to hybridize naturally; careful selections will be made and the process repeated

from year to year until a fixed variety is produced. Extensive tests are also in progress of varieties of Irish potatoes, with a view to find a sort better suited to the wants of our market growers than those now planted. The varieties of potatoes are now so numerous that private growers cannot afford to keep pace with them and find out what are good and what are worthless. In the multitude of new seedlings annually offered, a valuable sort is occasionally produced, and we will endeavor to keep our growers posted as to such. We have this season twenty-two varieties growing. In sweet potatoes there is an endless confusion in the South. Here, in North Carolina, it is hard to find any variety pure, as nearly all growers plant a heterogeneous mixture of several sorts. Such a course is destructive to any profit which might be made in shipping sweet potatoes North. The sorts which suit North Carolina people are not the sorts which Northern people want. The demand there is for a dry, yellow potato of smooth and uniform size; and no mixture of big and little, rough and smooth of half a dozen sorts will bring any profit to the grower. The Nansemond, Hayman or Southern Queen, Delaware and Virginia Red Nose are the leading sorts in the Northern market, while the yams of various sorts are more popular here. We are growing eleven sorts and hope yet to get more, and get at some correct idea of their respective productiveness and quality.

In tomatoes an extensive test of varieties is in progress. Forty named sorts are now being grown. They will be tested as to their respective earliness, smoothness, solidity, productiveness and adaptability, both for shipping and canning. Various methods of forwarding the crop and different modes of training will be tried.

In garden peas we have over forty sorts growing. The early sorts, commonly grown for Northern shipment, will be compared with the higher flavored and productive sorts usually confined to private gardens, and the advisability of using some of these finer sorts for market purposes tested.

In early cabbages, we want a sort as early as the Wakefield, but of larger size, and with this object in view we propose to experiment in developing cross-bred seedlings from a large number of sorts we will grow this season. In late cabbages, the object will be to find a sort that can be grown here with a reasonable degree of certainty; and we will also experiment as to the best time for sowing seed and setting the plants for the late crop. In this connection efforts will be made to find effectual means for destroying the harlequin bug and the "green worms," so-called, the larvæ of *Pieris Rapae* and *Plusia Brassica*, which are so destructive to cabbages here. Experience has shown that *fresh* Pyrethrum powder has, so far, been the most effective remedy. But much of the Pyrethrum powder sold is stale and worthless. Large quantities of this powder are annually sold by Raleigh druggists for fly powder, and if it can be produced here, there would be quite a home market for it. To test this, we

propose to grow this season a quantity of plants of *Pyrethrum Roseum* and *Pyrethrum Cinnerarifolium* for the purpose of drying the flowers and making the powder, and hope to produce a home-grown article equal to the California product. It has recently been stated that an infusion made from these flowers is fully as effective as the powder. This, also, will be tried.

In the line of fruit trees and small fruits, large additions have been made to the sorts already planted. Forty varieties of apples, forty of peaches, forty of plums, and a number of grapes have been planted. We append to this statement a list of all the fruits now growing. The grape interest in this part of the State has assumed proportions which justify every effort we can make in testing new sorts and producing cross-bred varieties here. With a view to raising new crosses between our native sorts and the fine varieties of *Vitis Vinifera*, we have procured a number of the best exotic sorts, which will be grown under glass for the purpose of cross-fertilization and raising of new seedling sorts. The large number of native varieties of grapes now growing at the Station Farm offer every facility for this work, and a large part of our work in fruits will be in the line of producing improved varieties adapted to the needs of growers. In strawberries, particularly, this will be done, for we yet lack an early sort fully equal to the requirements of our shippers in all respects. We have received from the Department of Agriculture thirty-six varieties of fig cuttings. These have been propagated and will be grown for the purpose of distributing to those parts of the State where wanted—cuttings of the best sorts collected from all parts of the world. We can see no reason why Eastern North Carolina should not grow and pack figs with profit. We have also received from the Department seed of a California plum (*Prunus subcordata*). This is a hardy sort which grows in the mountains of Modoc county, 4,500 feet above the sea, and is believed to be promising for its own fruit and as a variety to cross with others. We have also received sixty-one plants of the hardy Japanese Orange, *Citrus (Limonia) Trifoliata*, which is a handsome shrub and an excellent hedge plant. Its fruit is small and seedy, but is said to make good marmalade. It is perfectly hardy, as trees of it planted by the writer ten years ago in Northern Maryland are now fruiting freely. Another Japanese orange, which is said to be a fine table fruit and perfectly seedless, has lately excited a great deal of discussion in regard to its hardiness. Some parties claim that it has endured unhurt a degree of cold 10° below zero. Others deny this, but all agree that it is much hardier than other sweet oranges. The evidence in favor of its hardiness is such that we have thought it worth testing, and have therefore planted four trees. This orange has been imported under several names. First it came as "Satsuma," then as "Oonshiu," and now one San Francisco importing house calls it simply the "Kiu Seedless." We propose to expose two of our trees fully

from the start. The other two will be protected while young. While not placing great reliance on the reported hardiness of this orange, the writer well remembers that in 1880 he was laughed at for planting the *Citrus Trifoliata* in Maryland with the expectation of finding it hardy. But when, the following winter, it passed through 18° below zero unhurt, the question of its hardiness was settled. There is, therefore, a chance that the Satsuma may stand our winters in Central and Southern North Carolina.

We are preparing to illustrate at the Station Farm all the various methods of pruning and training grapes, both on trellis and on stakes, so that our growers can have an object-lesson in each. The results on the crop of the various systems will be carefully studied. Heretofore our vineyards in North Carolina have largely escaped the ravages of the black-rot, which render grape growing so uncertain North of us. But the fungus is here, and if our growers do not attack it in the start, we will soon repeat the experience of the Virginia vineyards, where the business was almost ruined by the fungus. As this black-rot is the worst of all the fungoid troubles of the grape, we give here the remedies which have proved effectual elsewhere when perseveringly applied. The most effective is the Bordeaux Mixture, to be used with a spraying pump on canes and stakes before vegetation starts, and a weaker form of the same to be used after foliage develops.

The following is the receipt for "Bordeaux Mixture:" Dissolve 16 pounds sulphate of copper in 22 gallons of warm water. In another wooden vessel slack 30 pounds of quick-lime in 6 gallons of water—when the lime has cooled pour it slowly into the copper solution, taking care to mix it thoroughly. The second solution, to be used by spraying over the young foliage ten days before blooming, and again after blooming, and once every three weeks until the fruit colors, is as follows: Sulphate of copper, 4 pounds in 16 gallons of water, to be mixed as in the first mixture with 4 pounds of lime, slacked in 6 gallons of water.

Make both mixtures several hours before using, and always in wooden vessels. Use a pump and Vermorel spraying nozzle made of copper and brass.

We propose to make special studies of the fungoid diseases of plants and also of the various insect enemies and to devise remedies for both. We, will therefore, be glad to receive at any time affected foliage and shoots of fruit trees and vines, and also specimens of troublesome insects, and for the farmers and fruit growers of North Carolina to correspond with us freely on any subject of interest to them.

Very little has been done at any of the stations in the line of ornamental horticulture and arboriculture. The florist and nursery interest is annually increasing in importance, and while not neglecting the useful, we are decidedly of the opinion that the Station

should do something towards showing our farmers how to make home beautiful. With a view to make an ornamental display on the Station and College grounds, we invited the leading florists to make contributions for this purpose, and have received collections, so far, from Messrs. Peter Henderson & Co., New York; Pitcher & Manda, New Jersey; Nanz & Neuner, Kentucky; Ellwanger & Barry, New York; and others are promised. We will begin upon the College grounds the formation of an arboretum, which we hope will eventually contain all the trees and shrubs which can be grown in this climate. The value of such a collection to the public and to the students cannot be over-estimated. Preparation has been made to build a new greenhouse on the College grounds, and part of the material is now in hand. When this is completed the present greenhouse at the Station will be devoted entirely to the various investigations necessary to be done under glass, and the production of ornamental plants transferred to the College greenhouse. We will thus have space for much scientific work which we cannot now attempt.

Our thanks are due for seeds and plants to Messrs. Henderson & Co.; George Tate, of Norfolk, Va.; Nanz & Neuner, Louisville, Ky.; T. W. Wood & Son, Richmond, Va.; Pitcher & Manda, Short Hills, N. J.; Burpee & Co., Philadelphia; Johnson & Stokes, Philadelphia, and others.

The following is the list of fruits now growing at the N. C. Experiment Station:

APPLES.

May yellow, North Carolina Red June, Ever-bearing, Early Harvest, Red Astrachan, Summer Rose, Eccles' Summer, Lady, Mother, Averoe's Favorite, Hunge, Magnum Bonum, Grimes' Golden Pippin, Olive, Autumn Strawberry, Carolina Beauty, Vine, Rue's Reliance, Franklin, Queen Pippin, Edwards, Fouville, York Imperial, Kinard's Choice, McCuller's winter, Albemarle Pippin, Ben Davis, W. W. Pearmain, Nansemond Beauty, Yellow Transparent, Alexander's ice cream, Haines' seedling, July cluster, VanHoy's no-core, Pride of Texas, Hernodler, Striped June, Gully, Hall, Summer Pearmain, Limbertwig, Wine Sap, Maiden's blush, Lucy Duke, Shockley, L. W. May, Mattamuskeet, Neverfail, Fall Pippin, Vandevere, Horse, Boston russet, May, Pine stump, John Ellis, O'Brians orange, Clark's pearmain.

PEARS.

Keiffer—Beurre d' Anjou, Sheldon, Morgan.
Lawrence—Belle lucrative, Duchesse d' Angouleme.
Beurre Gifford—Bartlett, Vicar of Winkefield, LeConte.
Clapp's Favorite—Buffum.

PEACHES.

Waterloo, Alexander, Early Rivers, Stump the world, Bordeaux cling, General Green, Oldmixon free, Beer's Smock, Crawford's early, Crawford's late, China cling, Salway, Steadley, Chairs' choice, Wheatland, Elberta, Heath cling, Butler's late, Bilyeu's October, Peen-to, Levy's late, Hawkin's winter, Shipley's late, Globe, Fox's seedling, Keyport, La Grange, Wonderful, Chairs' blood, Flatu's St. John, Preston cling, Lord Palmerston, Swann free, Snow free, Snow cling, Fluellen, Picquett's late, Scott's October, White English cling, Early Tillotson, Tippecanoe, Arkansaw Traveler, Mountain Rose, Mad. Johnson, Albright's October, Early Beatrice, Eaton's golden, Hayne's Surprise, Early Louise. Nix October, Wake Forest.

PLUMS.

Wild goose, Golden beauty, Prunus Pissardi, Prunus Simoni, Kelsey's Japan, Botan, Satsuma blood, Prince's yellow gage, Bingham, Prince's Englebert, Imperial gage, German prune, Reine Claude, Shipper's pride, Large blue, Quackenboss, common Blue Damson, Shropshire Damson, Holme's large early blue, Coe's golden drop, Green Gage.

CHERRIES.

Governor Wood, Black Tartarian, Luelling, Early Purple, Yellow Spanish, Elton.

QUINCES.

Orange, Anger's, Champion.

NUTS.

Hard-shell almond, soft-shell almond, English walnut, Pecan, Black walnut, American chestnut.

GRAPES.

Agawam, Bacchus, Black eagle, Black pearl, Brighton, Catawba, Champion, Clinton, Concord, Cottage, Cunningham, Cynthiana, Delaware, Diana, Duchess, Elvira, Etta, Eurmelan, Empire State, Goethe, Green's golden, Hartford prolific, Herbemont, Herbert, Herman, Isabella, Ives, Irvine's October, Lady Lutie, Lindley, Louisiana, Martha, Massasoit, Missouri, Reisling, Merrimac, Moore's early, Montiflore, Noah, Morton's Virginia, Niagara, Perkins, Prentiss, Pocklington, Salem, Taylor's Bullitt, Telegraph, Triumph, Wilder,

Worden, Advance, Alvey, Amanda, Amber, Arminia, Black Defiance, Brant, Bottsii, Cambridge, Canada, Cassady, Challenge, Conqueror, Cornucopia, Crevelling, Croton, Devereaux, Dracut Amber, Elsinburg, Eva, Faith, Imperial, Humboldt, Janesville, Lenoir, Marion, Maxatawney, Miles, Neosho, New Haven, Northern Muscadine, North Carolina, Oriental, Othello, Pauline, Peter Wylie, Rentz, Regna, Rogers No. 2, Secretary, Transparent, Uhland, Venango, Waverly, Whitehall, Welding, Wyoming red, Amber Queen, Beauty, Centennial, Early Victor, Eldorado, F. B. Hayes, Highland, Jefferson, Jessica, Lady Washington, Mason, Naomi, Norfolk, Pearl, Rochester, Virginus, Woodruff Red, Green Mountain.

EXOTIC GRAPES.

Champion Hamburg, Golden Hamburg, Black Muscat of Alexandria, Austrian Muscat, Black St. Peters, Black Hamburg, White Tokay, Sultana.

FIGS.

Adriatic, Dom Pedro, Brunswick, Brown Turkey, White Genoa, Black Ischia, White Marseilles, Black Marseilles, Black Dattato, White Dattato, Brianzola, Rubada, White Brogiotto, Black Brogiotto, Smyrna, Trojano, San Vito, Dalmatino, San Piero, Guiglionio, Castle Kennedy, Roi des Noirs, Pegustrata, Poulette, Brown Ischia, Angeli-que, Black Boujarotte, White Boujarotte, Early Violet, Grosse Verte, Pitaleuse, Violette de Bordeaux, Negro Largo, Black Province, Boujarotte Grise, Osborn's Prolific.

RASPBERRIES.

Hansel, Brandywine, Rancocas, Philadelphia, Cuthbert, Carolina Gregg, Souhegan, Schaffer.

BLACKBERRIES.

Kittatinny, Lawton, Erie, crystal white, Lucretia dewberry, Wilson Jr., Hoosac.

STAWBERRIES.

Wilson's Albany, Chas. Downing, Bidwell, Crescent, Sharpless, Monarch, Kentucky, Cumberland, Captain Jack, Iron-clad, Minor, Howell, Jessie, Parry, Windsor, Hoffman, Van Deman.

CURRANTS.

Fay's prolific, Black Naples.

GOOSEBERRIES.

Houghton, Downing.

OSIER WILLOWS.

We have also received through the Department of Agriculture, from Austria, cuttings of thirteen varieties of Osiers or basket willows, of which the following is a list:

- Salix Amygdalina canescens.*
- Salix Amygdalina Latifolia.*
- Salix Purpurea* × *Viminalis.*
- Salix Viminalis* queue de Renard.
- Salix Viminalis* Red Rough of Galicia.
- Salix Viminalis* Green Rough of Galicia.
- Salix Viminalis* high growing, mixed.
- Salix Viminalis* Cinnamonia.
- Salix Viminalis* Alepecuroides.
- Salix Viminalis* Merriniana.
- Salix Viminalis* Stricta.
- Salix Viminalis* Sedanensis.
- Salix Purpurea* Schultzeana.

These have been planted in suitable land, and will be grown for the purpose of distributing cuttings to those who wish to test the best varieties of basket willows known.

Our object will be at all times to make the horticultural work of the Station of practical use to our farmers by disseminating cuttings and seedling plants grown here for trial elsewhere, and the Horticulturist desires to put himself in communication with farmers and fruit-growers in all parts of the State, and to be consulted by them on all questions of interest.

AGRICULTURAL DIVISION.

REPORT OF THE AGRICULTURIST.

J. R. CHAMBERLAIN.

The Agriculturist has been employed much of the time during the year in attending to the details in constructing the new farm and dairy buildings, regular farm work incident to putting the land into suitable condition for experimental work, and the prosecution of experiments. Some of the experiments will be reported under the following heads:

Grass Plots and Forage Crops.

Benefits of Cow Peas to the Wheat Crop with and without various commercial fertilizers.

Benefits to Cotton, derived from the use of certain commercial fertilizers and stable manure (Reported by the Director).

The construction of hill-side ditches, cotton-seed hulls and meal as a cattle-food for fattening purposes.

Permanent Meadow and Pasture Plots. (Reported by the Botanist).

GRASS PLOTS AND FORAGE CROPS.

In order to test the value of various kinds of clover and grass, small plots were laid off and the following kinds of seeds sown:

GRASS PLOTS.

Clovers.—Alsike, crimson or German, white, red, pea-vine, yellow suckling, Japan, black medic, lucerne, Bokkhara, fenugreek, sanfoin, honey or bee clover, seradella.

Grasses.—Scurvy grass, English rye grass, Italian rye grass, crested dogs-tail, Bermuda grass, orchard grass, meadow fox-tail, slender fox-tail, yellow oat grass, Louisiana grass, annual sweet vernal, perennial sweet vernal, red-top, creeping bent, meadow brome, awnless brome, water meadow grass, wood meadow grass, rough-stalked meadow grass, fowl meadow grass, June grass, Texas blue grass, meadow fescue, tall fescue, sheep's fescue, fine-leaved fescue, red fescue, hard fescue, various-leaved fescue, timothy grass, Johnson grass, teosinte, hair grass, velvet grass.

While the plots were heavily manured with commercial fertilizers at the time of sowing, and in the middle of the summer had an application of nitrate of soda, yet the ground was too poor to grow the grass and clover and hold it against the hot summer sun. It is

barely possible that if the seeds had been sown in September instead of the middle of March, the results would have been more satisfactory. The plots which show some promise are the following, so far as making a firm sod is concerned (in order of the apparent excellence): Japan clover, pea-vine clover, red clover, tall fescue, orchard grass, meadow fescue, red-top, creeping bent, Italian rye, English rye. The other plots show very little, if any, promise.

FORAGE CROPS.

On land adjoining the grass plots the following forage crops were planted in plots $\frac{1}{30}$ of an acre in size, with the expectation of making a comparative test:

Kaffir corn, Egyptian rice corn, new Brazillian flour corn, improved evergreen broom-corn, improved dwarf broom-corn, early amber sugar cane, early orange sugar cane, early rural branching sorghum, prolific tree bean, soja bean or Japan pea, pearl millet, Canada field peas, white; Canada field peas, blue; flax, sunflower, silver ramie.

The land planted in these crops was of such a character, and the season so unfavorable, that no reliable results can be tabulated.

EXPERIMENT TO TEST THE VALUE OF PEA-VINE MANURING FOR WHEAT.

A people blessed with such a climate and soil as possessed by North Carolina, should be independent of the outside world for all the necessities of life. Her people should raise all the hay, cattle, butter, oats, wheat, etc., consumed within her borders, and furnish a surplus to meet the wants of her less fortunate neighbors. If every farmer in the State would try and raise enough supplies for his own use, and stop this apparently never-ceasing drain on the cash received from the sale of the so-called money crops, the total saving and increase in wealth of the individual, and of the State as a whole, would be wonderful to contemplate. As a people, we are buying ourselves poor. Shall we continue in this old and dangerous rut? Why not establish a system of farming conducive to prosperity? Rotation of crops with clover, grass and stock is our only hope for the future.

There are portions of the State where rotation is not possible; but Piedmont and Western North Carolina, with her clay and loamy soils, with proper care and management, could be made one hundred fold more productive than at present, with proper tillage.

In a rotation of crops, wheat is an important factor. Wheat can undoubtedly be made profitable when grown in connection with other crops, as a part of a system. To grow it exclusively is to invite disaster, which sooner or later is sure to come to a one-crop system.

In the cultivation of wheat, as with all other crops, the farmer must exercise care and forethought in the preparation of the soil, and procure, if possible, those conditions which suit the peculiar requirements of the crops in question. More attention should be paid to the mechanical condition of the soil, and less to the purchasing of commercial fertilizers. If it is necessary to furnish plant-food, then let only those elements needed be supplied, so that the cash expenditure will be as small as possible. The wheat plant loves a compact soil. In order to get this condition, the ground should be plowed and harrowed several weeks before seeding. Early plowing is particularly necessary when wheat is sown after clover and peas, since these crops tend to lighten up the soil.

In order to test the value of pea vines for wheat, together with various commercial fertilizers used alone and in conjunction with the "peas," a plot of ground at the Experimental Farm, near Raleigh, was selected for the experiment.

The soil is very poor and close, consisting of a sandy loam with a yellow clay subsoil. Cabbage was raised for a spring crop in 1888, and after it was gathered, black cow-peas were sown on one-half the ground and the other half allowed to grow up in crab grass. The pea vines attained a rank growth, but owing to their late sowing did not reach maturity. The ground for the experiment was plowed the middle of October, in order that the ground might settle before sowing the wheat.

Seven plots were laid off for the purpose of the experiment here detailed. One-half of each plot was on land sown previously in peas and plowed under, the other half on land without peas. A space of ten (10) feet was left vacant between land sown with peas and that without, so that in working no earth from one side would be drawn over into the other. Each plot, as sown, was 130 feet long, by 13 feet 3 inches wide, containing one-twenty-fifth ($\frac{1}{25}$) of an acre.

The rate at which the various fertilizers were sown on each plot, is shown in the following table:

<i>No. Plot.</i>	<i>Fertilizers per acre.</i>
1.....	No fertilizer.
2.....	300 pounds Kainit.
3.....	300 pounds Acid Phosphate.
4.....	{ 175 pounds Acid Phosphate. }
	{ 87½ pounds Cotton-seed Meal. }
	{ 37½ pounds Kainit. }
5.....	No fertilizer.
6.....	300 pounds Cotton-seed Meal.
7.....	{ 350 pounds Acid Phosphate. }
	{ 175 pounds Cotton-seed Meal. }
	{ 75 pounds Kainit. }

The ground, beginning at plot 1, rises gradually to plot 7. As may be expected, the ground diminishes in fertility in proportion to

its elevation. The fertilizers were sown broadcast and harrowed in just before sowing the wheat, which was done November 13th, 1888. The kind of wheat sown was Fultz and Fulcaster, mixed in equal proportions, at the rate of one and one-half bushels per acre.

During the fall and winter there was no perceptible difference in the appearance of the plots, with the exception of the one (No. 6) fertilized with cotton seed-meal, which had a thinner stand. This condition was noticed from the time the wheat came up till the straw was half grown. By this time the wheat had stooled so much that to the eye there was no difference in thickness of stalks between this and other plots. This plot, however, was a little later in ripening, and had a slightly deeper green color up to the time of maturity.

As has been stated, one-half of each plot had cow peas plowed under, so that we can compare the two ends of each plot and see what benefit, if any, was derived from the use of peas. This divides the plots into two distinct series, each fertilized exactly alike, and subjected to exactly the same condition, with the exception of the pea vines. In the table below is given the weight of grain and straw, weight of grain, and yield of grain per acre. The fertilizers used was given in previous table:

PLOTS WITH PEA VINES.

No. of Plot.	Weight of grain and straw per acre.	Weight of grain per acre in pounds.	Number bushels per acre.	
1	5.525 lbs.	1,540 lbs.	25 bus.	40 lbs.
2	5.625 "	1,750 "	29 "	10 "
3	6.576 "	1,900 "	31 "	40 "
4	6.475 "	1,550 "	25 "	50 "
5	5.575 "	1,400 "	23 "	20 "
6	5.624 "	1,400 "	23 "	20 "
7	5.375 "	1,350 "	22 "	30 "

PLOTS WITHOUT PEA VINES.

1	3.925 lbs.	950 lbs.	15 bus.	40 lbs.
2	3.875 "	850 "	14 "	10 "
3	4.550 "	1,100 "	18 "	20 "
4	3.355 "	1,000 "	16 "	40 "
5	3.135 "	800 "	13 "	20 "
6	3.925 "	1,050 "	17 "	30 "
7	3.575 "	940 "	15 "	40 "

It will be noticed that on plots 1 and 5, which had no fertilizers, there is in each case a gain of *10 bushels* per acre in favor of pea vines plowed under. In plots 2 and 3, where fertilizers were used, as above table shows, the increase on the pea-vine land is 15 bushels and $13\frac{1}{2}$ bushels nearly, respectively, which seems to prove that kainit and acid phosphate do well when used in conjunction with pea-vines:

No. Plot.	Application of Fertilizer per acre.	Cost.	Yield without Peas.		Yield with Peas.	
1	None	\$.....	15 bus.	40 lbs.	25 bus.	40 lbs.
2	300 pounds Kainit	2.10	14 "	10 "	29 "	10 "
3	300 pounds Acid Phosphate	2.63	18 "	20 "	31 "	40 "
4	{ 175 Acid Phosphate..... } { 87½ Cotton-seed Meal..... } { 37½ Kainit	2.84	16 "	40 "	25 "	50 "
5	None .....	.....	13 "	20 "	23 "	20 "
6	300 pounds Cotton-seed Meal.....	3.60	17 "	30 "	23 "	20 "
7	{ 350 Acid Phosphate..... } { 175 Cotton-seed Meal..... } { 75 Kainit..... }	5.68	15 "	40 "	22 "	30 "

Total yield, seven acres without pea-vines	111 bus.	20 lbs.
Average yield per acre.....	15 "	54 "
Total yield of seven acres with pea-vines.....	181 "	30 "
Average yield per acre.....	25 "	55 "
Average increased yield per acre from use of pea vines,	10 "	1 "

In studying these figures one will find some contradictory conclusions. One single experiment does not prove a truth. In the fall of 1889 this experiment was repeated, and probably will be continued several years. In view of these facts, it will be better to wait till the series of experiments have been finished before farther conclusions be presented.

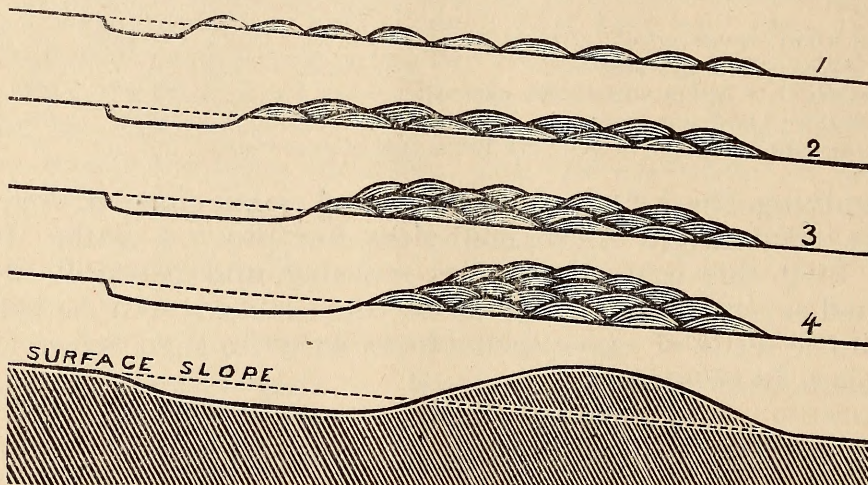
HILL-SIDE DITCHES.

Many acres of land in North Carolina are being ruined by washing rains. The destruction of hill-sides from this cause can only be remedied by the construction of ditches, to hold and carry away slowly the surplus water precipitated by violent showers. The labor and cost of constructing ditches has in many cases prevented their use. Very often ditches are constructed on the wrong principle. They are so made that the water is confined in narrow and deep channels, which causes the water to flow very rapidly, and frequently leads to the formation of deep gullies. Opposed to this mode of construction is the broad, shallow ditch which spreads the water over considerable surface, and by doing so friction is increased, and thus the water passes off much slower than in the narrow ditch. Water running in considerable volume in a broad ditch is apt to wash very little, and particularly so if the bottom of the ditch has a uniform grade. The broad ditch has another advantage which should not be lost sight of. It can be cultivated, ditch-bank and all, and by this means the field is kept clear of all objectionable weeds and grass, and of all obstructions to passing over the field with wagon in any and all directions. Broad ditches can be more easily made than deep ones, since all dirt can be moved with a plow. The only hand work necessary is in marking the location where the ditch is to be

constructed. In doing this some sort of a leveling instrument should be used. It is never safe to run a hill-side ditch simply with the eye. In order that it may not wash, the water must be made to run slowly and regularly down its course. It is very seldom best to have the fall more than twenty inches in 100 feet.

CONSTRUCTION.

After the line has been marked out indicating the position of the ditch a furrow is made on that line. A reversible hill-side plow is best, as one can plow coming and going.



PROCESS OF CONSTRUCTION.

This furrow is the one indicated above at the right of sketch No. 1.* Another furrow is then turned from above against this first one, and so on till the desired width is reached, perhaps ten feet or more, depending on the steepness of the hill. When the desired width has been secured we have a small ditch, the furrow as represented at the left hand of No. 1 of figure. The second plowing is then made. This time we commence and turn over furrow number two of the first plowing on number one of the first plowing and so on till we reach the last furrow plowed in the first plowing, when we have a ditch two furrows wide as seen on left of No. 2. By repeating this process the ditch and bank grow gradually in size, something as represented in No. 3 and 4 of the cut. Finally, the ditch and bank assume the general outline as shown in the lower representation of cut. The number of plowings necessary depends on the condition of the ground, slope of hill, plowman and plow. The land will be left rather rough, but this will be no defect, since more water will be

*NOTE.—The sketches are not accurately drawn, but they probably are sufficient to indicate in a general way the method of construction.

retained to soak into the soil, a condition of some value in a dry season.

The ditch is necessarily made more than one furrow deep, sometimes, depending on the slope of the hill. When these large ditches are used the entire field can be cultivated, ditch and all, thus saving much inconvenience and loss of land. We add to the bank the amount washed down from its crest during the season by turning the land every time we break the ground towards the top of the bank, or rather we place the back furrow on top of the ditch bank. In this way the height of the bank and the depth of the ditch is increased yearly, or every time a plowing is made.

The expense of constructing a broad ditch after this manner is reduced to a minimum cost, and with a little care is kept in perfect condition. It is surprising how rapidly a ditch can be made with a plow. There are unbelievers who have to make one to be convinced.

COTTON-SEED MEAL AND HULLS FOR FATTENING PURPOSES.

In many portions of the South the custom of feeding live stock, particularly cattle, with cotton-seed hulls, instead of what is commonly called "long feed," has become a common practice. In certain localities many animals are fattened each year on an exclusive diet of cotton-seed hulls and cotton-seed meal.

Many tons of hulls are yearly burned in the cotton-seed oil mills for fuel and the ashes used in the manufacture of commercial fertilizers. It would be a great saving to the mills if all the hulls could be sold for feeding purposes, since at two or three dollars a ton it is a very expensive fuel, and on the other hand, if hulls could be safely fed, the farming community would realize a great advantage in the cheap production of beef for home consumption.

In order to test the value of cotton-seed hulls and meal as a cattle food in a practical way, a series of experiments were commenced in the spring of 1889. It is a well understood fact in stock feeding that animals do not take on flesh as readily in warm or spring weather as in the autumn months, but it was thought best to commence this important investigation as soon as our farm buildings were completed sufficiently for this kind of work.

From appearances cotton-seed hulls are about as tasteless and uninviting food as can be found. They consist of seed coats, entangled in a mass of cotton fibres, which the ginning power fails to remove. The hull itself is very tough and leathery, and when taken into the mouth is harsh, almost tasteless, and very dry. They possess but few inviting features as a food, and it is surprising to see how greedily animals devour them, sometimes leaving good hay to eat this apparently indigestible linty food.

Animals of all kinds, as well as men, desire a variation in food.

A diet of one or two materials continued for several months at a time is not the best and most economical way of getting value in the shape of flesh from food stuffs. There should be a variation. Undoubtedly the safest and best way to feed hulls is in conjunction with hay, wheat bran, corn, pea and cotton-seed meals in order that there may be a variety. In view of the fact that many people use cotton-seed hulls and cotton-seed meal exclusively, it was thought best to study the question from that standpoint.

From the chemical analyses made in several Southern States, it is evident that the composition of cotton-seed hulls varies greatly. It is probable that this variation depends more on the thoroughness with which the kernels are separated from the hulls than on anything else. If any considerable amount of "meats" is entangled in the hulls, there will be a proportionate increase in the food-value of the hulls and a corresponding variation in chemical composition.

In the table is given the average composition of each ingredient of cotton-seed meal and cotton-seed hulls, taken from published results of Stations in Tennessee, Texas, Arkansas, Mississippi, New York and North Carolina:

	Cotton-seed Meal.	Cotton-seed Hulls.
Fat.....	11.16	1.60
Crude fiber.....	5.18	46.00
Nitrogen-free extract.....	25.07	43.13
Protein.....	43.97	4.19

As is the case with all feed stuffs, only a portion is digestible or capable of being assimilated by the animal. The digestibility of certain feeding stuffs has been determined by actual experiments upon animals. As yet no digestion experiments have been conducted to find the digestibility of cotton-seed hulls and meal. Hence, we are obliged to assume that the digestibility of these materials is very like materials of similar composition in which the digestibility has been determined.

In the following table the digestibility of cotton-seed hulls and cotton-seed meal is given, assuming that the former is like wheat straw and the latter like linseed cake. It is believed by the writer that this assumption is not correct, although perhaps nearly accurate. This belief is based on indications presented by cattle in the course of experiments that more of a certain kind of food was required by them than the figures given indicate was necessary:

DIGESTIBLE CONSTITUENTS OF COTTON-SEED HULLS AND MEAL.

	COTTON-SEED MEAL.			COTTON-SEED HULLS.		
	Percent- age Com- position, Pounds in 100.	Per cent. of Constit- uents Di- gestible.	Pounds Digestible in 100 lbs. Meal.	Percent- age Com- position, Pounds in 100.	Per cent. of Constit- uents Di- gestible.	Pounds Digestible in 100 lbs. of Meal.
Fat	11.16	91*	25.39	1.60	27	1.08
Crude Fiber	5.18	26	1.34	46.00	52	23.92
N-free extract ..	25.07	91	22.81	43.13	40	17.25
Protein	43.97	87	38.25	4.19	26	1.09
	Nutritive	ratio.	1: 1.29	Nutritive	ratio.	1: 38.75

*In making this calculation the fat is multiplied by $2\frac{1}{2}$, since its value is regarded that much greater than that of the other carbohydrates.

The specimens used in this experiment were oxen from six to twelve years old, and not at all uniform in character. Considerable difficulty was experienced in getting suitable animals, probably because it was the time of year when there was plenty of grass. It took several days to teach the animals to eat the hulls readily, so the experiment did not commence as soon as the cattle were put in the stable. At all times as many hulls were given them as would be eaten up clean, and the amount of meal was increased from three pounds per day till enough had been given to cause the dung to become less firm.

The maximum amount given, after the experiment was commenced, was six pounds. At no time, in the opinion of the writer, could that amount of meal be increased without danger of injury to the animal. These animals were fed three times a day, one-third the feed for the day at each meal. After feeding in the morning the cattle were turned out in a large shed for exercise and water, also in the afternoon. No record of the water drank was kept, each animal using as much as was desired. The weighing was done each Monday morning before feeding.

It should be kept in mind that this feeding experiment was conducted more as a preliminary investigation to notice the effect of the food used, etc., on the animals, in order to be in position to conduct future experiments with a better understanding of the work in hand. It is, therefore, thought best at this time only to give tables of the records of each animal, and in future publications to give the profit and loss and more details, when suitable animals can be secured for the experiment.

It has been well established, however, that cotton-seed hulls and meal are suitable and profitable for the purpose of fattening cattle; that they are healthful foods, and that the quality of beef is excellent.

Black ox, about six years old, poor type for good feeder. Long legged, light hips. Fed ten days before experiment commenced.

May.	Hulls Eaten.	C. S. Meal Eaten.	Weight in morn'g bef're feeding.	June.	Hulls Eaten.	C. S. Meal Eaten.	Weight in morn'g bef're feeding.
21	14 lbs.	5 lbs.	832 lbs.	26	20 lbs.	6 lbs.	
22	14 "	6 "		27	20 "	6 "	
23	15 "	6 "		28	20 "	6 "	
24	15 "	6 "		29	20 "	6 "	
25	15½ "	6 "		30	20 "	6 "	
26	16 "	6 "		July.			
27	16½ "	6 "		1	20 "	6 "	906 lbs.
28	17 "	6 "	876 lbs.	2	20 "	6 "	
29	17 "	6 "		3	20 "	6 "	
30	17 "	6 "		4	20 "	6 "	
31	17 "	6 "		5	20 "	6 "	
June.				6	20 "	6 "	
1	17 "	6 "		7	20 "	6 "	
2	17 "	6 "		8	20 "	6 "	900 lbs.
3	17 "	6 "	876 lbs.	9	20 "	6 "	
4	18 "	6 "		10	20 "	6 "	
5	18 "	6 "		11	20 "	6 "	
6	18 "	6 "		12	20 "	6 "	
7	18½ "	6 "		13	20 "	6 "	
8	19 "	6 "		14	20 "	6 "	
9	19 "	6 "		15	20 "	6 "	
10	19 "	6 "	862 lbs.	16	20 "	6 "	920 lbs.
11	19½ "	6 "		17	20 "	6 "	
12	20 "	6 "		18	20 "	6 "	
13	20 "	6 "		19	20 "	6 "	
14	20 "	6 "		20	20 "	6 "	
15	20 "	6 "		21	20 "	6 "	
16	20 "	6 "		22	20 "	6 "	914 lbs.
17	20 "	6 "	886 lbs.	23	20 "	6 "	
18	20 "	6 "		24	20 "	6 "	
19	20 "	6 "		25	20 "	6 "	
20	20 "	6 "		26	20 "	6 "	
21	20 "	6 "		27	20 "	6 "	
22	20 "	6 "		28	20 "	6 "	
23	20 "	6 "		29	20 "	6 "	
24	20 "	6 "	906 lbs.	30	20 "	6 "	
25	20 "	6 "		31	20 "	6 "	916 lbs.

Bob-tail, about eight years old, good feeding form. Experiment commenced ten days after feeding commenced.

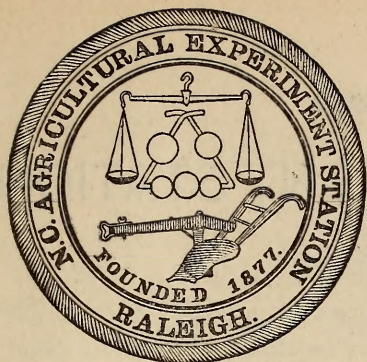
May.	Hulls.	C. S. Meal.	Weight.	June.	Hulls.	C. S. Meal.	Weight.
21	16½ lbs.	6 lbs.	890 lbs.	26	20 lbs.	6 lbs.	
22	16½ "	6 "		27	20 "	6 "	
23	16½ "	6 "		28	20 "	6 "	
24	16½ "	6 "		29	20 "	6 "	
25	16½ "	6 "		30	20 "	6 "	
26	16½ "	6 "		July.			
27	16½ "	6 "	944 lbs.	1	20 "	6 "	
28	17 "	6 "		2	20 "	6 "	980 lbs.
29	17 "	6 "		3	20 "	6 "	
30	17 "	6 "		4	20 "	6 "	
31	17 "	6 "		5	20 "	6 "	
June.				6	20 "	6 "	
1	17 "	6 "		7	20 "	6 "	
2	17 "	6 "		8	20 "	6 "	
3	17 "	6 "	943 lbs.	9	20 "	6 "	1,000 lbs.
4	18 "	6 "		10	20 "	6 "	
5	18 "	6 "		11	20 "	6 "	
6	18 "	6 "		12	20 "	6 "	
7	18½ "	6 "		13	20 "	6 "	
8	19 "	6 "		14	20 "	6 "	
9	19 "	6 "		15	20 "	6 "	
10	19 "	6 "	938 lbs.	16	20 "	6 "	940 lbs.
11	19½ "	6 "		17	20 "	6 "	
12	20 "	6 "		18	20 "	6 "	
13	20 "	6 "		19	20 "	6 "	
14	20 "	6 "		20	20 "	6 "	
15	20 "	6 "		21	20 "	6 "	
16	20 "	6 "		22	20 "	6 "	
17	20 "	6 "	950 lbs.	23	20 "	6 "	1,024 lbs.
18	20 "	6 "		24	20 "	6 "	
19	20 "	6 "		25	20 "	6 "	
20	20 "	6 "		26	20 "	6 "	
21	20 "	6 "		27	20 "	6 "	
22	20 "	6 "		28	20 "	6 "	
23	20 "	6 "	986 lbs.	29	20 "	6 "	1,000 lbs.
24	20 "	6 "		31	20 "	6 "	
25	30 "	6 "					

Scrub, about twelve years old ; hard-looking specimen. Fed several weeks before experiment began.

May.	Hulls.	C. S. Meal.	Weight.	June.	Hulls.	C. S. Meal.	Weight.
21	16½ lbs.	6 lbs.	788 lbs.	26	18 lbs.	6 lbs.	
22	16½ "	6 "		27	18 "	6 "	
23	16½ "	6 "		28	18 "	6 "	
24	16½ "	6 "		29	18 "	6 "	
25	16½ "	6 "		30	18 "	6 "	
26	16½ "	6 "		July.			
27	16½ "	6 "		1	18 "	6 "	
28	17 "	6 "	780 lbs.	2	18 "	6 "	
29	17 "	6 "		3	18 "	6 "	828 lbs.
30	17 "	6 "		4	18 "	6 "	
31	17 "	6 "		5	18 "	6 "	
June.				6	18 "	6 "	
1	17 "	6 "		7	18 "	6 "	
2	17 "	6 "		8	18 "	6 "	
3	17 "	6 "	788 lbs.	9	18 "	6 "	
4	18 "	6 "		10	18 "	6 "	828 lbs.
5	18 "	6 "		11	18 "	6 "	
6	18 "	6 "		12	18 "	6 "	
7	18½ "	6 "		13	18 "	6 "	
8	19 "	6 "		14	18 "	6 "	
9	19 "	6 "		15	18 "	6 "	
10	19 "	6 "		16	18 "	6 "	840 lbs.
11	19½ "	6 "	788 lbs.	17	18 "	6 "	
12	20 "	6 "		18	18 "	6 "	
13	13 "	4 "		19	18 "	6 "	
14	18 "	6 "		20	18 "	6 "	
15	18 "	6 "		21	18 "	6 "	
16	18 "	6 "		22	18 "	6 "	
17	18 "	6 "		23	18 "	6 "	848 lbs.
18	18 "	6 "	812 lbs.	24	18 "	6 "	
19	18 "	6 "		25	18 "	6 "	
20	18 "	6 "		26	18 "	6 "	
21	18 "	6 "		27	18 "	6 "	
22	18 "	6 "		28	18 "	6 "	
23	18 "	6 "		29	18 "	6 "	850 lbs.
24	18 "	6 "		30	18 "	6 "	
25	18 "	6 "	806 lbs.				

Since the above feeding experiments were finished, others have been made under more favorable circumstances. In the latter experiments, a handsome cash balance has been made, not taking into consideration the value of the manure.

The details and exact profits in these experiments will be given in a future bulletin.



Oct. 15, 1889.

North Carolina

Agricultural Experiment Station,

Bulletin No. 67a.

Technical Bulletin No. 1.

I. SEED TESTS.

Publications will be sent to any address upon application.

NORTH CAROLINA

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AND STATE WEATHER SERVICE,

UNDER THE CONTROL OF THE

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RALEIGH, N. C.

At the time that the Experiment Station Bulletin No. 59 was published, August—September, 1888, a series of examinations of field seeds, mainly grass seed, had been made. The result was startling in the extreme, as the average value was only fifty-six per cent., one hundred per cent. expressing both absolute purity and absolute vitality. The Station refrained from making known the names of dealers who sold these seed, on the broad basis that the retail dealers might not themselves have known the exact character of the seed they had on sale. It was specified, however, that the farmer was the sufferer, and as the prime object of the Experiment Station was for the advancement of the State's agriculture, the improvement of the seed used was of the greatest necessity.

In this present bulletin the work of seed examination has been extended to embrace all the more common garden seed found on sale. The result has been almost as decided as that recorded for field seeds. Although there have been found many varieties of seed, both pure and vital, yet some of the seed on sale show decided evidence of careless handling, in that they were old, musty, and stale. If certain classes of seed are not vital after a year's keeping, then the farmer and seed merchant certainly should become acquainted with the fact. The Station refrains now from publishing, as before, the names of dealers from whom the seed were purchased, for the reason, that possibly those who sold the worthless seed were not aware of the fact, or that they were ignorant of the property that these seed possess of becoming worthless when old. In the future, seed merchants must not expect such forbearance.

A single extract from a paper read by Mr. J. E. Northrup, of Minneapolis, before the Minnesota State Horticultural Society, will show what deception, some seed-houses adopt, and the consequent care which ought to be taken to prevent such practice from becoming wide-spread:

"In walking through a large seed warehouse some time since, I detected the odor of burning brimstone, and my curiosity was aroused as to what part brimstone could play in the fitting of seed for market. Making some pretext for visiting that portion of the building from whence the fumes proceeded, I came to some cucumber seed, which was being bleached to remove the yellow tint with which age had mellowed it. The tags on the bags indicated that it had been in that building over twenty years, and how much longer no one knows."

In the preparation of seed, then, for the market, adulteration and deception must be guarded against, as much so as in other mercantile professions.

H. B. BATTLE, *Director*.

I.
SEED TESTS.

BY GERALD MCCARTHY, BOTANIST.

During the year 1889 the North Carolina Experiment Station has completed analyses and tests of about 1,500 samples of seed. A large portion of these samples were purchased by the Station in North Carolina or sent for examination by farmers; the rest were procured directly from the seedsmen who put them up, and were, in most cases, donated to the Station. It is only fair to the various seedsmen, whose seeds have been tested and reported upon in this BULLETIN, to acknowledge that, with the exception of clovers and lucerne seed, most of the different kinds of seeds tested were found true to name and reasonably free from impurities. The low vitality shown by many of the samples—such, for instance, as those contained in the Table II—were due to staleness of the seeds. Stale seeds, unless they have been “doctored,” are easily recognizable by an experienced person. They are usually lustreless, which is due to the absorption of the oil, which is always present in the seed-coat of fresh seeds. When stale seeds are found in packets, the containing packets are more or less stained and dirty, and such seeds should never be purchased. Stale lucerne seed has lost its shiny, greenish color, and become dull and brown and more or less withered. Red clover seed also becomes brown with age. In our warm and humid climate, the vitality of seeds, and especially of Northern-grown seeds, deteriorates very rapidly; and seeds of two years old are, as a rule, not worth sowing. Yet, we find that most retail dealers in seeds act in utter disregard of this fact. They seem to think the quality of seeds in packets, like that of meats in cans, is of indefinite duration, and “warranted to keep in any climate.” Except clover and grass-seeds, nearly all seeds sold in this market are put up in sealed packets, which are marked with the name of the seedsman who put them up. Some seedsmen place upon their packets the words “warranted” or “guaranteed,” but as no details as to the nature of the warrant or the quality guaranteed are given, this must be regarded as a mere bait to catch the credulous. Most seedsmen distinctly disclaim all responsibility for the quality of the seeds in their packets.

The jeweller warrants his watches and rings to be of a certain fineness and weight; the honest dry goods man warrants his wares to be all-wool, or all-linen or as the case may be; and so also with the shoe dealer, grocer and other merchants. There is no real and valid reason why the seed merchant should not also give a real and definite guarantee of the quality of his wares! The necessity of such a guarantee, for the protection of the purchaser, is much more urgent in regard to seeds than in any of the above-mentioned cases. The first cost of seeds is comparatively small, compared with the

expense of preparing and fertilizing the ground, and if the seed sown proves to be worthless, or of a different species from that claimed, by the time the fact becomes apparent the season for sowing has passed, and the defrauded purchaser loses, not only all he has invested in seeds, fertilizer, land and labor, but also the value of his prospective crop. In Europe all respectable seedsmen give a positive and definite guarantee of the purity and vitality of their seeds, and there is no reason why American seedsmen should not do the same. So long, however, as seedsmen think they can force their wares, on their own terms, upon the consumer, no advance of this kind need be expected, and just so long will the long-suffering public be annoyed and defrauded by stale and weed-infested seeds. Seedsmen, when asked to give a definite guarantee of their goods, reply that their reputation is the only guarantee they can offer, and that is sufficient for the protection of the purchaser! But this claim is utterly fallacious. There are in all trades rascals who, under pretense of honest trading, fleece all whom they can inveigle into their power, and these same rascals may be among the ones who most loudly prate of their reputation. Reputation is a good thing, but business is business, and should be conducted upon business-like principles. The purchaser of seeds may have an unblemished reputation for honesty, but if he were to go into the store of any of these same seedsmen who demand that purchasers shall accept their goods upon the guarantee of their reputation, and offer a piece of unstamped metal in payment for seeds, he would be very likely to discover that the rule of "reputation" does not work both ways. Moreover, nearly all American seedsmen sell the title to their seeds to the retailer, without any real and practicable restriction upon the latter. The retailer naturally thinks he is at liberty to do as he likes with his own seeds, and he generally likes to sell them without inquiring too closely into their quality.

The art of seed-testing upon scientific principles was instituted in 1870, by Dr. Frederick Nobbe, Tharand, Germany, and it has now in European countries reached such perfection as to give entire satisfaction to all concerned. The custom is, in Europe, for seedsmen to sell seeds under a specific guarantee of purity and vitality. The purchaser is at liberty to have the seeds tested by certain public seed-control stations, or by botanists employed by agricultural societies. If the seeds fail to come up to the quality guaranteed, the purchaser has the right to demand a commensurate reduction in price, or he may, if he prefers, return the seeds to the seller and get his money back, the seller being required to pay the cost of freight on the seeds. This fair and business-like arrangement has resulted in driving out of the markets adulterated seeds, while the freedom of commercial seeds from noxious weed-seeds has become greatly increased. Before 1870, when Prof. Nobbe began his useful work, there were several establishments in Europe engaged in the manu-

facture of bogus clover seeds from quartz rock. The quartz was first crushed and, by means of sieves, graded to the size of different species of clover seeds; it was then colored to imitate the seed which it was meant to adulterate. Prof. Nobbe has shown that in a single year certain English seed firms, and among the most "honorable" in the trade, have purchased tons of this bogus seed. Just how much of this quartz clover reached America, we are not yet able to say, but we have an agent in Europe investigating the matter, and we hope before long to be able to lay the result before the public.

The following form of guarantee is given by a large English seed association, and is, in effect, similar to that given by all European seedsmen:

1. "Our seeds are sold guaranteed pure, clean and of the percentage of vitality named in our catalogue.

2. "This guarantee is subject to the analysis of the botanist of the Royal Agricultural Society.

3. "If the result of the analysis does not confirm the above guarantee, the association will take back the seeds and pay cost of carriage both ways, but seeds must not be sown before making complaint.

4. "The seeds once sown, the responsibility of the association ceases. The result depends upon so many things besides the quality of the seeds that the growth cannot be guaranteed."

This is fair trade and common sense, creditable alike to English seed merchants and English seed purchasers. Where such trade customs prevail there can be no room for "mistakes." Honest and careful seedsmen are protected from the unfair competition of the unscrupulous. The purchaser is assured that he gets just what he wants and pays only for what he gets.

The North Carolina Experiment Station has extensive and very complete arrangements for testing seeds, and its services are at the command of any farmer or seed-user in North Carolina free of charge. Being desirous of introducing a higher grade of seeds into our markets, the Station will publish in an ensuing BULLETIN the names of seedsmen who are willing to give purchasers of their seeds residing in North Carolina a guarantee similar in effect to that quoted above. We invite correspondence on this matter.

The Station has nearly ready for publication, and will shortly publish, the details of a Standard of Quality for the different kinds of seeds more commonly used. In the same BULLETIN we will describe the apparatus and methods used for testing seeds in this Station, and in other American and European Experiment Stations.

It has been thought best to omit, in the present BULLETIN, the names of retail dealers from whom seeds were purchased. Hereafter the names of retailers will be published in connection with the seeds purchased of them, and those who are found selling poor and worthless seeds may expect no further forbearance on the part of this Station.

TABLE I.—LANDRETH'S SEEDS. BOUGHT IN RALEIGH, N. C.

Station Numb'r.	Name.	No. of days before first sprout appeared.	No. of days before last sprout appeared.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5471	Beet, Bassano	5	18	99	62.	61.38	255	7,229
5480	Cabbage, E. J. Wakefield	3	6	100	92.5	92.5	350	9,922
5506	Cabbage, Large Drumhead	2	6	100	80.	80.	318	9,015
B. 580	Cabbage, L. L. Drumhead	2	10	100	75.5	75.5	380	10,773
5483	Mustard, Brown	1	4	100	84.	84.	1,090	30,901
5498	Lettuce, E. Curled	3	15	100	73.	73.	92	2,608
5493	Spinach, Prickly	4	30	100	70.	70.	290	7,521
5505	Collards, Southern	2	6	100	78.	78.	178	5,046
5507	Mustard, White	1	3	100	100.	100.		
5834	Salsify	10	21	95	27.	25.65		
5835	Parsnip, H. Crowned	7	18	94	41.	39.33		
5836	Carrot, Lt. Orange	3	10	100	67.5	67.50		
5838	Collards, Marrow	5	12	100	10.	10.		
B. 504	Pepper, Cayenne	7	16	100	75.5	75.5	215	6,095
B. 507	Egg Plant	5	16	100	34.5	34.5	240	6,804
B. 583	Onion, E. Red	2	6	100	92.5	92.5	236	6,690
5866	Tomato, Feejee	3	14	98	58.	56.8	295	8,363
5882	Okra, Dwarf	4	12	99	70.	69.3	17	482

DISCUSSION OF TABLE I.—All the above seeds were put up in packets and sold two for five cents. All except Nos. B. 580, B. 504 and B. 583, were stamped "1889." Those excepted were stamped "1888." These are, with a few exceptions, good seeds.

TABLE II.—ELY'S SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5650	Cabbage, L. L. Drumhead	4	10	100	45.5	45.5	248	7,030
5651	Cabbage, Brunswick Drumhead	3	7	100	9.	9.	279	7,654
5652	Cabbage, L. L. Bergen	7	8	100	4.	4.	-----	-----
5653	Cabbage, L. L. F. Dutch	3	9	100	51.	51.	-----	-----
5670	Cabbage, E. Fr. Oxheart	4	9	100	12.	12.	268	7,597
5671	Cabbage, E. J. Wakefield	3	14	100	58.	58.	262	7,427
5669	Sprouts, Brussels	4	4	100	1.	1.	336	9,525
5837	Parsley, Dbl. Curled	0	0	100	0.	0.	-----	-----
5839	Cucumber, W. Spine	3	6	100	46.3	46.3	-----	-----
5840	Beet, W. Sugar	5	19	100	72.5	72.5	-----	-----
5841	Asparagus, Colossal	0	0	100	0.	0.	-----	-----
B. 585	Onion, Mammoth Silver King	0	0	100	0.	0.	220	6,237
B. 584	Borecole	3	9	100	39.	39.	200	5,670
B. 590	Watermelon, Ironclad	3	9	100	84.	84.	10	283
B. 591	Tomato, K. of Earlies	2	6	100	89.5	89.5	-----	-----

DISCUSSION OF TABLE II.—The above seeds were purchased in retail packets, and were sold at the same price as fresh seed. The discolored packets and the lustreless seeds suggested that they were stale seeds, and the test fully confirmed the suspicion. The retailer subsequently acknowledged that these were old seeds and claims that they were sold to us by mistake. The packets in which these seeds were put up, were marked "Warranted," but neither the grower nor the retailer have offered to refund the money paid by us for the seeds.

TABLE III.—ELY'S SEEDS—BOUGHT IN GREENSBORO, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 505	Egg Plant.....	4	16	100	31.	31.	240	6,804
B. 511	Tomato, E. Acme.....	2	9	95	93.	88.3	330	9,355
B. 512	Tomato, Livingston's Perfection.....	2	18	100	81.	81.	330	9,355
B. 513	Salsify, Mammoth.....	4	21	100	83.	88.	76	2,154
B. 514	Beet, Egyptian.....	4	12	94	66.	62.	90	2,551
B. 515	Beet, E. B. Turnip.....	5	16	100	44.	44.	54	1,531
B. 518	Muskmelon, Golden Gem.....	4	8	98	82.	80.3	36	1,020
B. 519	Muskmelon, Jenny Lind.....	4	7	100	98.	98.	37	1,045
B. 520	Muskmelon, Nutmeg.....	4	8	98	74.	72.5	33	935
B. 521	Squash, E. Bush.....	3	5	100	86.	86.	12	348
B. 522	Squash, E. Crookneck.....	3	6	100	92.	92.	12	348
B. 526	Cucumber, E. G. Cluster.....	2	5	100	86.	86.	40	1,134
B. 527	Cucumber, L. Green.....	2	6	98	88.	86.2	34	1,163
B. 536	Watermelon, Ice Cream.....	3	6	100	68.	68.	13	368
B. 537	Watermelon, Mountain Sweet.....	3	5	96	62.	59.5	7.5	212
B. 538	Watermelon, Sealy Bark.....	2	4	100	84.	84.	9.5	260
B. 539	Watermelon, L. Rattlesnake.....	2	4	100	77.5	77.5	9	255
B. 540	Watermelon, Kolb's Gem.....	2	5	100	92.5	92.5	8	226
B. 550	Cabbage, L. L. Drumhead.....	1	9	100	78.	78.	-----	-----
B. 551	Cabbage, E. Etampes.....	2	11	100	62.	62.	-----	-----
B. 552	Cabbage, E. Winingstadt.....	1	11	100	92.	92.	-----	-----
B. 553	Cabbage, L. L. F. Dutch.....	1	7	100	82.	82.	-----	-----
B. 554	Cabbage, E. Drumhead.....	1	10	100	91.	91.	-----	-----
B. 555	Cabbage, E. Dwarf York.....	1	11	100	87.	87.	-----	-----
B. 582	Cabbage, all seasons.....	2	8	100	76.	76.	342	9,695

DISCUSSION OF TABLE III.—The packets in which the above seeds were purchased were bright and clean. The quality as will be seen by the column headed "valuation" is, with a few exceptions, good. These were not stale seeds!

TABLE IV.—BURPEE'S SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 573	Cabbage, E. J. Wakefield.....	3	9	100	34.5	34.5	222	6,293
B. 574	Cabbage, L. L. F. Dutch.....	3	9	94	32.	32.	248	7,020
B. 575	Cabbage, Henderson's E. Summer.....	3	9	100	53.	53.	316	8,958
B. 576	Cabbage, E. Jersey Wakefield.....	3	9	66	28.5	28.5		
B. 577	Cabbage, E. Cannon Ball.....	9	9	100	12.	12.		
B. 578	Cabbage, Fottler's Brunswick.....	6	9	100	5.5	5.5	426	12,077
B. 579	Cabbage, Surehead.....	5	9	100	33.	33.	280	7,428
B. 580	Cabbage, Short-stem Drumhead.....	3	9	100	57.	57.	350	7,428
B. 581	Cabbage, E. Deephead.....	4	10	100	44.	44.	336	10,026
B. 587	Squash, R. China.....	3	9	100	39.5	39.5	9	9,525
B. 588	Cucumber, Giant Pera.....	3	9	100	94.	94.	25	255
B. 589	Muskmelon, Bay View.....	2	9	99	75.5	74.7	31	709
								879

DISCUSSION OF TABLE IV.—The above seeds were put up in packets and were sold at the price of fresh seeds of the same kind. The packets were very much discolored and showed the effects of much handling. The seeds lacked lustre and No. B. 576 was badly weevil eaten. Messrs. Burpee inform us that they have sold no seeds to the firm we purchased these from since February, 1886. Hence, the above seeds were at the very latest, of the growth of 1885, or four years old. It must be remembered that a laboratory test is always more favorable than a field test would be, and it is most probable that not one seed out of one hundred of these cabbage seeds would produce a good plant.

TABLE V.—CROSSMAN BROS. SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5475	Beet, Bassano	6	18	99	78.	77.2	120	3,402
5494	Radish, E. Scarlet	2	5	100	39.5	39.5	925	26,253
5499	Lettuce, E. Curled	3	8	100	60.5	60.5	290	8,221
5484	Onion, White	5	13	100	17.	17.	295	8,263
5474	Cabbage, E. Winningstadt	4	6	97	26.	25.2	225	6,378
5476	Cabbage, E. F. Dutch	2	6	100	83.	83.	38	1,077
5488	Cucumber, E. G. Cluster	3	10	100	60.	60.	775	21,971
5482	Mustard, S. Giant	1	5	100	92.	92.	105	2,976
5491	Spinach, Summer	2	11	100	18.	18.	362	10,252
5500	Tomato, Acme	2	8	100	91.	91.	5.75	163
5858	Corn, Sugar	3	6	100	74.	74.	5.25	148
5859	Corn, Stowell's Evergreen	3	6	100	50.	50.		

DISCUSSION OF TABLE V.—The above seeds were purchased in retail packets costing from five to fifteen cents each and were advertised as "New Crop Seeds." The packets were rather dirty and the seed looked stale. The low vitality of the corn seed showed conclusively that these were at least three years old.

TABLE VI.—FERRY'S SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5795	Collards, Georgia.....	2	9	100	82.5	82.5	256	7,257
5796	Cabbage, E. Dwf. F. Dutch	2	6	100	93.	93.	244	6,917
5797	Cabbage, Pr. F. Dutch	1	6	100	90.	90.	250	7,087
5798	Cabbage, E. Drumhead	1	9	100	75.	75.	254	7,202
5799	Cabbage, E. J. Wakefield	1	6	100	75.5	75.5	272	7,711
5817	Onion, Silverskin	4	11	100	76	76.	292	8,278
5818	Radish, E. Scarlet	1	4	98	59.5	58.3	106	3,005
5819	Spinach, Prickly Seed	4	13	97	34.5	33.4	99	2,806
5842	Beet, E. Bassano	4	9	96	36.	34.5	46	1,304
5843	Okra, Dwarf White	4	30	100	80.	80.	19	359
5844	Lettuce, Simpson's Curled	2	14	100	49.	49.	640	18,144
5845	Turnip, Purple W. Tip	1	4	100	90.5	90.5	600	17,010
5846	Onion, W. Portugal	2	7	100	61.5	61.5	300	8,505
5847	Salsify	4	20	100	53.	53.	103	2,920
5848	Carrot, L. Orange	3	9	96	65.	62.4	640	18,144
B. 503	Celery, Golden Heart	0	0	100	0.	0.	2,140	60,669
B. 506	Egg Plant	4	9	100	21.5	21.5	330	9,255

DISCUSSION OF TABLE VI.—The above seeds were purchased in retail packets and cost five cents each. The packets were fresh and clean. The quality with a few exceptions is good.

TABLE VII.—FERRY'S SEEDS—BOUGHT IN GREENSBORO, N. C.

Station Numbr.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 509	Celery, Seymour's Golden	7	28	100	38	38.	2,700	76,545
B. 561	Cabbage, Pr. L. F. Dutch	2	8	100	83	83.	300	8,505
B. 562	Cabbage, E. Winningstadt	2	9	100	76	76.	316	8,958
B. 563	Cabbage, Stone Mason Drumhead	2	7	100	76	76.	288	8,164
B. 564	Cabbage, L. Drumhead	3	9	100	75	75.	260	7,371
B. 565	Cabbage, L. E. York	3	8	100	32	32.	280	7,938
B. 566	Cabbage, E. J. Wakefield	2	5	100	74	74.	296	8,391
B. 530	Radish, L. B. Spanish	2	7	99	70	69.3	118	3,345
B. 528	Cucumber, E. Russian	2	5	98	80	78.4	43	1,219
5867	Tomato, L. Perfection	2	10	96	87	83.3	350	9,922
5869	Tomato, Canada Victor	3	15	99	72	71.2	420	11,909
5881	Squash, B. Scallop	2	7	99	86	85.1	11	312
5883	Cucumber, E. W. Spine	2	4	99	82	81.1	41	1,162

DISCUSSION OF TABLE VII.—The above seeds were purchased in retail packets and the packets were fresh and clean.

TABLE VIII.—CLEVELAND'S(?) SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5470	Beet, Egyptian	5	11	100	80.5	80.5	720	20,412
5473	Turnip, E. White	3	13	100	74.5	74.5		
5478	Cabbage, E. J. Wakefield	3	8	100	26.5	26.5		
5496	Radish, E. White	1	6	100	82.5	82.5	114	3,232
5502	Tomato, Mikado	2	8	100	92.5	92.5	342	9,695
5503	Collards, Southern	2	6	100	80.5	80.5	295	8,363
5497	Lettuce, Seymour's E. C	4	11	100	73.	73.		
B. 510	Lettuce, Prize Head	2	7	100	86.	86.	650	18,427
B. 502	Bean, Large Lima	2	6	100	96.6	96.6		
5875	Muskmelon, Cantaloupe	2	8	94	99.	93.	42	1,190
5876	Muskmelon, Nutmeg	3	7	99	97.	96.	29	822
5877	Muskmelon, Hackensack	2	6	99	99.	98.	42	1,190
5878	Pumpkin, Cheese	2	4	98	71.	69.5		

DISCUSSION OF TABLE VIII.—The above seeds were in retail packets and the packets were somewhat dirty. The name of the growers was not printed on the packets, that of the retailers being put in evidently to order. The style of packet and the way of doing business are those of Cleveland & Co., of New York, and presumably these seeds were put up by them. The quality of these seeds is above the average.

TABLE IX.—CLEVELAND'S (?) SEEDS—BOUGHT IN GREENSBORO, N. C.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 516	Muskmelon, G. Nutmeg	4	6	100	100	100	33	935
B. 517	Muskmelon, Hackensack	4	7	100	88.	88.	42	1,190
B. 523	Cucumber, W. Spine	3	5	100	36.	36.	43	1,219
B. 524	Cucumber, Improved L. G	2	6	100	80.	80.	36	1,020
B. 525	Cucumber, E. Cluster	2	5	100	90.	90.	39	1,005
B. 531	Radish, E. Short Top	2	9	100	81.	81.	78	2,211
B. 532	Watermelon, Ironclad	2	6	100	84.	84.	7.5	212
B. 533	Watermelon, Peerless	2	6	100	92.	92.	10	283
B. 534	Watermelon, Rattlesnake	2	6	100	76.	76.	9	255
B. 535	Watermelon, Mountain Sweet	2	6	100	94.	94.	11	311
B. 541	Pepper, Bullnose	3	13	95	61.	58.	152	4,359
B. 544	Tomato, Liv's. Beauty	2	5	100	92.	92.	312	8,845
B. 545	Tomato, Acme	2	5	100	85.	85.	308	8,731
B. 546	Tomato, Early Acme	3	6	100	92.	92.	322	9,184
B. 548	Onion, W. Silverskin	2	14	100	60.5	60.5	-----	-----
B. 549	Onion, Weathersf. Red	3	9	100	52.	52.	-----	-----
B. 557	Cabbage, L. F. Dutch	3	9	100	88.	88.	360	10,206
B. 558	Cabbage, Marblehead Mammoth	3	10	100	61.	61.	280	7,938
B. 559	Cabbage, L. L. Drumhead	3	9	100	62.	62.	312	8,845
B. 560	Cabbage, E. Etampes	3	10	100	75.5	75.5	288	8,165

DISCUSSION OF TABLE IX.—The above seeds were in retail packets and the packets were fresh and clean. The name of the growers was omitted and replaced on the packets by that of the retailers. Cleveland's seeds presumably. Quality above the average.

TABLE X.—BUIST'S SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numbr.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5472	Beet, Turnip	7	15	99	53.	52.	61	1,729
5477	Cabbage, E. F. Dutch	2	6	100	84.	84.	124	3,515
5479	Cabbage, E. J. Wakefield	3	6	100	74.	74.	275	7,796
5481	Cabbage, N. C. Buncombe	3	6	100	79.	79.	295	8,363
5485	Onion, Silverskin	3	9	100	89.	89.	295	8,363
5486	Onion, Y. Danvers	3	10	100	66.5	66.5	280	7,938
5487	Celery, Sandr. White	8	25	100	80.5	80.5	2 500	70,875
5489	Cucumber, E. Russian	6	17	99	58.5	57.9	153	4,394
5492	Spinach, Curled	3	7	100	85.5	85.5	124	3,515
5495	Radish, Fr. Breakfast	2	7	100	84.	84.	---	---
B. 529	Radish, B. Spanish	2	6	96	90.	86.4	---	---
B. 571	Sage	3	14	100	50.	50.	---	---
B. 572	Thyme	3	7	100	9.5	9.5	---	---
B. 570	Kale, Scotch	1	3	100	96.	96.	---	---
B. 569	Kohl-Rabi	2	8	100	80.	80.	---	---
B. 568	Carrot, E. S. Shorthorn	3	17	100	47.	47.	---	---
B. 567	Leek, Mammoth	2	17	96	51.	49.	---	---
B. 543	Pepper, Red Cherry	3	12	100	82.	82.	170	4,819
B. 542	Pepper, B. Spanish	3	12	98	70.	69.	136	3,855
B. 508	Egg Plant	5	18	100	59.	59.	240	6,804

DISCUSSION OF TABLE X.—The above seeds were in retail packets and the packets were clean and fresh. Quality fair. Such seeds as Egg plant, Pepper, Thyme, &c., never give a high percentage of vitality.

TABLE XI.—BUIST'S SEEDS—BOUGHT IN RALEIGH, N. C.

Station Numbr.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5854	Corn, Chester Co. Mammoth.	2	6	100	80.5	80.5	2.6	75
5855	Corn, Golden Dent.	2	6	100	98.	98.	2.5	72
5856	Corn, Adam's Sweet.	3	6	100	68.	68.	11.5	127
5857	Corn, Good Seed.	3	5	100	94.	94.	3.75	93
5860	Bean, China Red-eye.	3	6	100	100.	100.	1.75	50
5861	Bean, Sewee.	3	6	100	84.	84.	2.	56
5862	Bean, Black Wax.	3	6	100	92.	92.	2.75	78
5863	Bean, E. Valentine.	3	6	100	98.	98.	2.5	71
5864	Bean, E. Dwarf W. Wax.	3	6	100	90.	90.	2.75	78
5865	Bean, E. Golden Wax.	3	6	100	98.	98.	2.5	71
5870	Bean, E. Mow hawk.	2	4	100	92.	92.	2.	56
5871	Pea, Extra Early.	2	4	100	98.	98.	4.75	134
5872	Pea, Little Gem.	2	5	100	96.	96.	4.25	120
5873	Pea, Thom. Thumb.	2	4	100	100.	100.	4.	113

DISCUSSION OF TABLE XI.—The above seeds were in bulk and were purchased of a different firm from those on preceding table. Quality good.

TABLE XII.—LANDRETH'S SEEDS—DIRECT FROM THE GROWER.

Station Numbr.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity. per cent.	Vitality. per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5804	Cabbage, L. L. Drumhead	2	5	98	89.5	87.7	241	6,832
5805	Cabbage, L. L. Mountain	2	11	100	90.5	90.5	258	7,914
5806	Cabbage, Mammoth Bergen	2	11	100	95.5	95.5	316	8,958
5807	Cabbage, Ulm Savoy	3	7	99	51.5	50.9	304	8,618
5808	Cabbage, Green Glazed	2	10	100	73.	73.	388	11,000
5809	Kale, T. Scotch	2	4	100	99.5	99.5	434	12,304
5810	Collards, Southern	2	12	100	89.	89.	296	8,391
5811	Collards, Marrow	3	13	100	44.5	44.5	334	9,469
5812	Brocoli, L. E. White	3	11	100	62.	62.	418	11,850
5813	Sprouts, Brussels	2	10	100	88.5	88.5	284	8,051

DISCUSSION OF TABLE XII.—These seeds were purchased by the Station at the catalogue price and were sent from Philadelphia by mail, in half ounce packets.

TABLE XIII.—HENDERSON'S SEEDS—DIRECT FROM THE GROWER.

Station Number	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity, per cent.	Vitality, per cent.	Valuation, per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
5681	Bermuda Grass.....	10	30	100	52.	52.	4,140	117,369
5814	Cauliflower, Veitche's.....	2	7	100	88.5	88.5	462	13,099
5815	Cauliflower, Lenormand's.....	2	11	100	92.5	92.5	306	8,675
5816	Cauliflower, Algiers.....	2	11	100	77.5	77.5	360	10,206
5820	Cabbage, Marblehead.....	2	7	100	90.5	90.5	348	9,866
5821	Cabbage, Filderkraut.....	2	9	100	88.5	88.5	320	9,072
5822	Cabbage, Sel. L. Flat Dutch.....	2	9	100	69.	69.	328	6,464
5823	Cabbage, Autumn King.....	2	5	100	97.	97.	190	5,838
5824	Cabbage, Green-glazed.....	2	5	100	98.5	98.5	260	7,371
5825	Cabbage, Excel. Flat Dutch.....	2	4	100	87.5	87.5	300	8,505
5826	Cabbage, M'mth Rock Red.....	2	6	100	85.	85.	284	8,051
5827	Cabbage, Am. Drumhead Savoy.....	2	9	100	92.	92.	370	10,489
5828	Cabbage, Henderson's Succession.....	2	4	100	96.	96.	268	7,598
5829	Cabbage, Fottler's Brunsw.....	2	5	100	90.	90.	287	8,126
B. 592	Pyrethrum Roseum.....	4	28	100	67.	67.	360	10,206
B. 593	Johnson Grass.....	8	11	94	2.	1.88	280	7,938
B. 594	Japan Clover.....	3	9	100	76.	76.	820	23,247
B. 595	Pearl Millet.....	3	5	100	68.	68.	210	5,953
B. 596	Louisiana Grass.....	4	9	80	3.5	3.	940	26,649
B. 597	Randall Grass.....	3	14	98	44.	43.	720	20,412
B. 678	Texas Blue Grass.....	7	24	100	5.	5.	-----	-----

DISCUSSION OF TABLE XIII.—The above samples were received direct from Messrs. Henderson, and, with a few exceptions, sprouted very satisfactorily. Nos. B. 593, and B. 678, are grasses which never give a high per centage of sprouted seeds. Of these two samples, B. 593 was kept in apparatus for 45 days during July and August, with temperature ranging from 85° to 95°, plenty of moisture constantly present, yet at the end of 45 days, 90 per cent. of the seeds were hard. The seeds of this grass are usually harvested before they are fully ripe, as when ripe they shatter out very readily. This is probably the cause of the unsatisfactory test. No. B. 596 all molded after the 12th day. No. B. 678 were kept in the apparatus for 45 days, but gave no sprouts after the 24th day, and all were moldy at the end of test. The genus *Poa* seems to produce seed of lower vitality than any other cultivated grass.

TABLE XIV.—NUNGESSER'S SEEDS—DIRECT FROM THE GROWER.

Station Number	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity, per cent.	Vitality, per cent.	Valuation, per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 790	Vetch	1	6	96	95.5	91.6	27	765
B. 791	Sanfoin	4	12	97	51.	49.5	48	1,361
B. 792	Serradella	5	12	98	30.	29.	366	10,206
B. 793	Lucerne	1	27	100	80.	80.	480	13,608
B. 794	Alsike Clover	1	12	98	85.	83.	1,830	51,880
B. 795	Red Clover	1	29	100	89.	89.	722	20,468
B. 796	Grimson Clover	1	8	98	96.5	94.6	310	8,788
B. 797	Johnson Grass	6	20	90	23.	21.7	260	7,371
B. 798	Perennial Rye Grass	4	16	99	91.	90.8	610	17,293
B. 799	Italian Rye Grass	5	11	98	86.5	84.8	500	14,175
B. 800	Tall Oat Grass	5	16	98	84.	82.	410	11,623
B. 801	Orchard Grass	6	28	97	73.	71.7	1,200	34,020
B. 802	Meadow Fescue	5	18	99	71.	70.	610	17,293
B. 803	Perr. S. Vernal Grass	7	35	90	25.	22.5	2,200	62,370
B. 804	Timothy Grass	3	8	100	94.	94.	2,810	79,663
B. 806	Red Top Grass	3	11	96	53.	51.	10,600	300,510

DISCUSSION OF TABLE XIV.—The above samples of seeds were sent to the Station by Henry Nungesser, New York. The vitality is, in all cases, except B. 806, very high for the species given. The purity, also, is much above the average for grass and clover seeds.

TABLE XV.—LECOQ'S SEEDS. DIRECT FROM GROWER, DARMSTADT, GERMANY.

Station Number	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity, per cent.	Vitality, per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 680	Kentucky Blue Grass	0	0	99	0.	0.	4,560	129,276
B. 681	Wood Meadow Grass	4	24	98	17.	16.6	5,040	142,844
B. 684	Water Meadow Grass	0	0	96	0.	0.	3,100	87,885
B. 685	Annual Sweet Vernal Grass	10	30	98	8.	7.8	1,700	48,195
B. 686	Tall Oat Grass	3	30	99	63.	62.3	330	9,355
B. 687	Florin	2	9	98	34.	33.6	10,500	297,695
B. 688	Yellow Oat Grass	4	24	95	27.	26.	4,475	126,866
B. 689	Meadow Fox Tail	3	24	98	73.	71.5	1,120	31,752
B. 690	Meadow Fox Tail	3	18	99	69.	68.3	1,200	34,020
B. 691	Narrow-leaved Fescue	5	14	99	50.	49.5	4,900	138,915
B. 692	Sheep's Fescue	3	21	99	60.	59.5	1,420	40,275
B. 693	Hard Fescue	3	19	98	66.	64.7	1,380	37,124
B. 694	Red Fescue	7	19	99	17.	16.8	2,270	64,354
B. 695	Meadow Fescue	2	22	98	87.	85.3	570	16,159
B. 696	Meadow Fescue	3	15	98	90.	88.2	610	17,293
B. 697	Various-leaved Fescue	7	15	94	13.	12.2	1,570	55,849
B. 698	Randall Grass	3	11	99	72.	71.2	640	18,144
B. 699	Randall Grass	3	18	99	60.	59.5	740	20,979
B. 700	Orchard Grass	3	9	90	82.	74.	1,590	45,076
B. 701	English Rye Grass	3	9	99	82.	81.	500	14,175
B. 702	Italian Rye Grass	2	14	98	89.	87.2	590	16,726
B. 703	Crested Dog's Tail (1887 growth)	7	19	99	39.	38.6	2,600	73,710
B. 704	Crested Dog's Tail (1888 growth)	5	18	99	49.	48.5	2,560	72,576
B. 705	Velvet Grass (Holeu-s)	4	15	94	24.	23.	2,920	82,782
B. 706	Reed Canary Grass	4	15	100	13.	13.	1,900	53,863
B. 707	Yarrow (Achillea)	2	21	99	60.	59.4	9,280	263,088

DISCUSSION OF TABLE XV.—The above samples of seeds were received direct from LeCoq & Co., Darmstadt, Germany. The purity percentage is, in every case, very high for seeds of this kind, but the vitality percentage is rather low in many cases. These seeds were sent to us by mail, and it may be were injured in transportation.

TABLE XVI.—JAMES HUNTER'S SEEDS, CHESTER, ENGLAND. DIRECT FROM GROWER.

Station Number	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity, per cent.	Vitality, per cent.	Valuation, per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 767	Alsike Clover	2	8	99	89.	88.	1,675	47,486
B. 768	Red Clover	2	8	95	80.	76.	500	14,175
B. 769	Late Red Clover	2	8	99	90.	89.	590	16,726
B. 770	Tall Fescue	6	16	98	83.5	72.	594	16,840
B. 771	Meadow Fescue	6	16	100	76.	76.	556	15,763
B. 772	Hard Fescue	6	15	100	68.5	68.5	1,165	33,027
B. 773	Orchard Grass	12	23	100	82.	82.	885	25,393
B. 774	Meadow Foxtail	6	18	98	42.	41.	1,155	32,744
B. 775	Timothy	8	22	99	87.	86.	2,700	76,545
B. 776	Kentucky Blue Grass	12	12	100	1.	1.	4,325	122,613
B. 777	Crested Dog's Tail	10	36	100	90.	90.	1,890	81,931
B. 778	Perennial Rye Grass	2	16	100	89.	89.	472	13,381
B. 780	Italian Rye Grass	4	16	100	81.	81.	490	13,891

DISCUSSION OF TABLE XVI.—The above samples of seeds were received directly from Mr. Hunter, Chester, England, by mail. Both the purity and vitality percentages are unusually high for seeds of these kinds. The *Poas*, as usual, give the lowest percentage of vitality.

TABLE XVII.—U. S. AGRICULTURAL DEPARTMENT SEEDS.

Station Numbr.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 599	Serradella.....	7	13	97	4.	3.9	310	8,788
B. 600	Spurry, Giant.....	2	17	100	62.5	62.5	950	26,932
B. 601	Sulla.....	8	8	100	1.	1.	90	2,551
B. 602	Pea, Small.....	3	6	100	100.	100.	3	85
B. 603	Bean, Horse.....	5	11	100	66.	66.	3	85
B. 604	Clover, Honey.....	2	11	98	16.5	16.	415	11,765
B. 605	Lathyrus Hirsutus.....	4	18	100	65.	65.	37	948
B. 606	Vicia Sativa.....	2	4	97	71.	69.	22	623
B. 607	Pumpkin, Student.....	3	5	70	87.	61.	6	170
B. 608	Muskmelon, E. Gem.....	3	5	100	10.	10.	35	992
B. 609	Squash, N. E. Gem.....	5	12	100	36.	36.	15	425
B. 610	Watermelon, Perfection.....	4	6	100	82.	82.	11	111
B. 611	Cucumber, Nichols'.....	1	5	98	84.	82.	38	1,077
B. 612	Parsnip, Student.....	5	15	98	46.	45.	860	24,386
B. 613	Parsley, Moss-curled.....	7	17	100	32.5	32.5	640	18,144
B. 614	Carrot, Golden Orange.....	4	15	100	73.	73.	46	1,304
B. 615	Sanfoin.....	4	9	92	38.	33.	119	3,373
B. 616	Salsify, Mammoth.....	6	14	100	39.	39.	17	483
B. 617	Spinach, B. Savoy.....	3	9	100	18.	18.	830	23,530
B. 618	Okra, N. W. Velvet.....	2	12	100	63.	63.	60	1,701
B. 619	Lettuce, Deacon.....	4	7	100	3.	3.	59	---
B. 622	Beet, Edmond's Turnip.....	3	9	100	72.	72.	---	---
B. 623	Beet, Sugar.....	3	9	100	49.	49.	---	---
B. 624	Rutabaga, American.....	1	8	100	98.	98.	---	---
B. 625	Turnip, Purple-top.....	1	8	100	93.	93.	---	---
B. 626	Radish, Scarlet Globe.....	1	5	100	50.	50.	---	---
B. 627	Collards, Imp. Georgia.....	2	8	100	61.	61.	---	---
B. 628	Cauliflower, Eclipse.....	2	8	100	64.	64.	---	---
B. 629	Kale, Dwarf German.....	1	6	100	84.	84.	---	---
B. 630	Cabbage, Sturehead.....	2	8	100	80.	80.	11	311
B. 631	Cotton, Ellsworth.....	3	7	100	80.	80.	---	---

TABLE XVII.—U. S. AGRICULTURAL DEPARTMENT SEEDS—Continued.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity per cent.	Vitality per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 632	Cotton, Ellsworth	3	8	100	74.	74.	11	311
B. 633	Cotton, Champion Cluster	3	8	100	89.	89.	8.5	240
B. 634	Cotton, Welborn's Pet	3	7	100	81.	81.	9.5	269
B. 635	Cotton, Wimberly's Imported	3	7	100	78.	78	10.5	297
B. 636	Cotton, Ferrell's Prolific	4	7	95	30.	28.5	10.5	297
B. 637	Cotton, Truitt's Imported	4	11	100	84.	84.	8	226
B. 638	Sorghum, No. 53	2	5	100	81.	81.	45	1,275
B. 639	Sorghum, No. 26	2	5	100	82.	82.	55	1,559
B. 640	Sorghum, No. 57	2	5	100	83.	83.	50	1,417
B. 641	Sorghum, No. 51	2	5	100	90.	90.	48	1,361
B. 642	Sorghum, No. 68	2	5	100	90.	90.	45	1,275
B. 643	Sorghum, Unnamed (Ga)	2	5	100	72.	72.	45	1,275
B. 644	Sorghum, No. 15	2	5	100	89.	89.	50	1,417
B. 645	Sorghum, Unnamed (Texas)	2	5	97	66.	64.	44	1,247
B. 646	Sorghum, White India	0	0	100	0.	0.	48	1,361
B. 647	Sorghum, E. Tennessee	2	7	100	79.	79.	41	1,162
B. 648	Sorghum, Whitting's Early	2	7	100	91.	91.	49	1,389
B. 649	Sorghum, Price's N. Hybrid	2	7	100	87.	87.	56	1,587
B. 650	Sorghum, Swain's Golden	2	3	100	97.	97.	58	1,644
B. 651	Sorghum, Chinese	3	7	100	90.	90.	39	1,105
B. 652	Sorghum, Folger's Early	2	3	100	98.	98.	47	1,342
B. 653	Sorghum, Ennyama	3	3	100	2.	2.	48	1,361
B. 654	Sorghum, No. 46	2	5	100	77.	77.	48	1,361
B. 655	Sorghum, Gooseneck	5	7	100	11.	11.	48	1,361
B. 656	Sorghum, Waubensee	2	6	100	93.	93.	38	1,077
B. 657	Sorghum, E. Amber	1	4	100	90.	90.	51	1,446
B. 658	Sorghum, New Sugar Cane	2	6	100	91.	91.	47	1,332
B. 659	Sorghum, Planter's Friend	2	6	100	74.	74.	48	1,361
B. 660	Sorghum, Saccharatum	2	8	100	95.	95.	40	1,134
B. 661	Sorghum, Improved Orange	2	5	100	65.	65.	46	1,304
B. 662	Sorghum, Early Orange							

B. 663	Sorghum, Late Orange	2	7	92	11.	10.	58	1,644
B. 664	Corn, White Field	2	5	100	98.	98.	---	---
B. 665	Corn, Yellow Field	2	5	100	98.	98.	---	---
B. 666	Corn, Chicago Sweet	2	5	100	93.	93.	---	---
B. 667	Bean, L. Y. Six Weeks	3	7	100	92.	92.	---	---
B. 668	Corn, Ensilage	2	5	100	70.	70.	---	---
B. 669	Corn, R d Kaffir	2	7	100	92.	92.	---	---
B. 670	Corn, White Kaffir	2	6	100	76.	76.	---	---
B. 671	Corn, Brazil Flour	2	5	100	85.	85.	---	---
B. 672	Pea, R. N. Yorker	4	9	100	90.	90.	---	---
B. 673	Teosinte	2	16	100	67.	67.	---	---
B. 674	Rye Grass, Italian	2	10	96	61.	65.	---	---
B. 675	Blue Grass, Kentucky	6	11	94	3.	4.6	---	---
B. 676	Blue Grass, Texas	0	0	100	0.	0.	---	---
B. 677	Blue Grass, English	2	10	100	86.	86.	---	---
B. 781	R-scue Grass	4	22	95	67.5	64.	70	2,750
B. 782	Mangel Wurtzel	3	30	95	70.0	66.5	58	1,644
B. 783	Sanflower, Mammoth Russ	2	5	95	74.	75.	18	510
B. 784	Asparagus, Hub	8	27	100	77.	77.	47	1,332
B. 785	Onion, S autpt. Yellow Globe	4	11	100	25.	22.	304	8,618
B. 786	Rumie	5	22	100	45.	45.	19,620	556,276
B. 787	Honey Plant, Chapman's	2	9	100	72.	72.	58	1,644

DISCUSSION OF TABLE XVII.—The above samples of seeds were received directly from the U. S. Department of Agriculture. The purity was, in most cases, equal to the best quality of similar seeds put up by seed-men. The low vitality of several of the sorghum samples was due to weevil-eaten seed.

TABLE XVIII.—MISCELLANEOUS.

Stat'n Num- ber.	Name.	Source.	No. of days before first sprout.	No. of days before last sprout.	Purity, per ct.	Vitality per ct.	Valua- tion, per ct.	No. of seeds in one gram.	No. of seeds in one ounce.
5531	Lucerne	Purchased in Raleigh, N. C.	2	10	98	68.	66.6	540	18,144
5332	Lucerne	Purchased in Raleigh, N. C.	1	5	90	74.	69.6	460	13,041
B. 709	Lucerne	Purchased in Raleigh, N. C.	3	7	96	49.	41.	-----	-----
B. 717	Lucerne	Wood & Son, Richmond, Va.	7	18	98	80.	78.	-----	-----
5530	Red Clover	Purchased in Raleigh, N. C.	2	6	94	90.	84.	680	19,276
5679	Red Clover	Purchased in Raleigh, N. C.	2	4	95	88.	83.	730	20,695
B. 705	Red Clover	Purchased in Raleigh, N. C.	3	6	94	44.	41.	-----	-----
B. 706	Red Clover	Purchased in Raleigh, N. C.	2	6	90	95.	85.5	-----	-----
B. 707	Red Clover	F. M. Scroggs, Morgantown, N.C.	2	6	75	88.	66.	-----	-----
B. 708	Red Clover	Miller & Son, Lynchburg, Va.	2	4	96	85.	81.6	-----	-----
B. 715	Red Clover	Wood & Son, Richmond, Va.	2	6	95	83.	79.	-----	-----
B. 711	Crimson Clover	Purchased in Raleigh, N. C.	2	5	95	90.	85.5	-----	-----
5458	Kentucky Blue Grass	Purchased in Raleigh, N. C.	14	24	98	19.	18.6	6,540	182,857
5831	Kentucky Blue Grass	Purchased in Raleigh, N. C.	7	25	98	5.	4.9	5,190	147,136
5680	Johnson Grass	H. Post, Alabama	7	21	95	14.	13.3	390	11,156
B. 712	Fall Oat Grass	Miller & Son, Lynchburg, Va.	2	10	99	52.	51.5	-----	-----
B. 713	Randall Grass	Miller & Son, Lynchburg, Va.	2	12	99	50.5	50.	-----	-----
B. 500	Orchard Grass	Wood & Son, Richmond, Va.	7	18	98	77.5	76.	-----	-----
B. 501	Orchard Grass	Wood & Son, Richmond, Va.	7	21	94	55.	52.	-----	-----
5849	Corn, Stowell's Eng	Purchased in Raleigh, N. C.	3	8	100	100	100	5.5	157
5850	Corn, Black Mexican	Purchased in Raleigh, N. C.	4	9	100	94.	94.	3.5	82
5851	Corn, Adams' Early	Purchased in Raleigh, N. C.	4	9	100	86.	86.	4.5	127
5852	Corn, Golden Dent	Purchased in Raleigh, N. C.	5	10	100	80.	80.	2.5	61
5584	Pyrethrum Roseum	Jas. Vick, Rochester, N. Y.	4	17	99	52.	51.	340	9,639
5534	Onion, Bermuda W.	Wood & Son, Richmond, Va.	3	9	98	69.	67.6	-----	-----
5535	Onion, Southpt Globe	Wood & Son, Richmond, Va.	2	9	100	88.	88.	290	821
5800	Cabbage, All Seasons	Northrup & Co., Minn.	2	4	97	93.	91.7	256	7,257
5801	Cabbage, Gold. Savoy	Northrup & Co., Minn.	2	7	100	87.	87.	283	8,023

5802 Cabbage, Stone Mason Northrup & Co., Minn.	2	9	96	71.	68.	284	8,051
5803 Cabbage, Surehead .. Northrup & Co., Minn.	2	9	98	97.	95.	228	6,964
5853 Rutabaga .. D. Moore, Maine	2	5	100	94.	94.	334	9,469
B. 598 Rutabaga, Elephant, Carter & Co., London	1	4	100	99.	90.	336	9,525

DISCUSSION OF TABLE XVIII.—Of above samples, No. 5530 was found to contain five per cent. of broken quartz grains. These grains showed, under the microscope, a clean, ragged fracture, and were not grains of sand, but evidently the harvest of some convenient rock pile or mine. This sample was taken from a lot of seed said to have been grown in Davidson County, N. C. Nos. B. 708 and B. 709 contained nearly two per cent. of dodder—enough to poison a whole field. Nos. 5458 and 5831 gave only nineteen per cent. and five per cent. respectively of sprouted seeds, though kept in the apparatus for sixty days. Eventually they molded and were thrown out. It is the custom of botanists to count one-third of all the seeds remaining hard at the end of fifteen days as capable of sprouting, but in the case of these samples, such an allowance would not be correct, as no sprouts were obtained after the twenty-fifth day. No. 5680 gave no sprouts after the twenty-first day, though kept in apparatus for forty-five days, with temperature at 85° to 95°, and ample moisture. Eighty-six per cent. were sound at end of forty-five days.

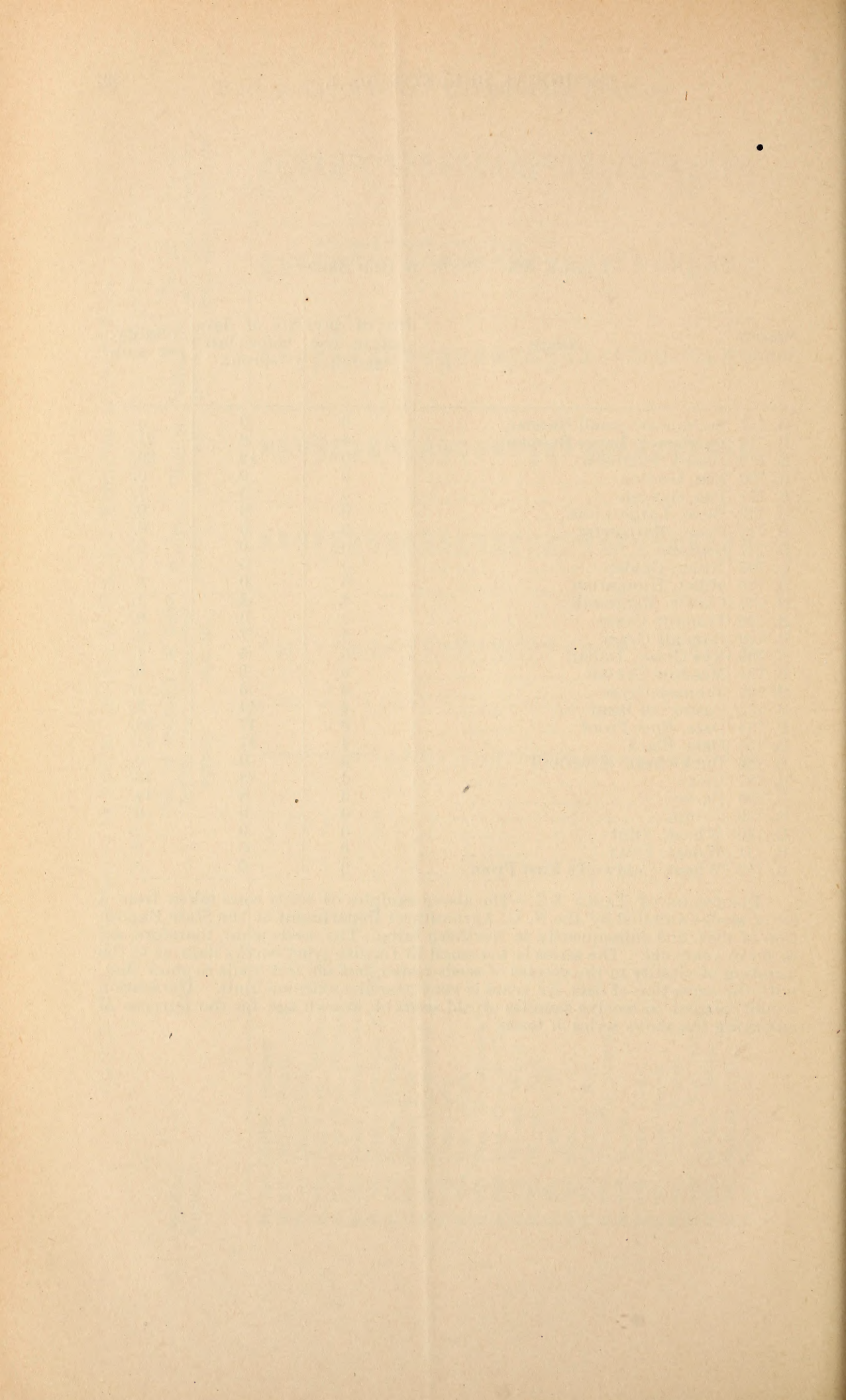
TABLE XIX.—SEEDS GROWN IN NORTH CAROLINA IN 1889, AND EXHIBITED AT STATE FAIR.

Station Numbr.	Name.	No. of days before first sprout.	No. of days before last sprout.	Purity, per cent.	Vitality, per cent.	Valuation per cent.	No. of seeds in one gram.	No. of seeds in one ounce.
B. 809	Millet, Golden.....	2	7	98	88	86.	556	15,762
B. 810	Millet, Pearl.....	3	12	98	82	80.	165	4,677
B. 811	Buckwheat.....	2	7	99	64	63.	48	1,361
B. 812	Pop Corn, White.....	1	4	100	100	100	8.5	240
B. 813	Pop Corn, Purple.....	1	4	100	100	100	8.5	240
B. 814	Bean, Lima (Sieva).....	2	15	100	94	94	2.5	71
B. 815	Bean, Henderson's Bush, Lima.....	2	15	100	100	100	2.5	71
B. 816	Bean, Wonder.....	5	6	100	80	80	1.5	42
B. 817	Bean, Pole.....	2	4	100	85	85	4.5	127
B. 818	Pea, Black-eyed.....	2	6	100	92	92	5.5	156
B. 819	Pea, Lady.....	1	2	100	100	100	8.5	241
B. 820	Pea, Black.....	1	16	100	92	92	4.5	127
B. 821	Pea, Whippoorwill.....	1	4	100	86	86	5.5	156
B. 822	Pea, Cow or Clay.....	4	6	100	98	98	6.5	184
B. 823	Wheat, White.....	2	6	100	82	82	22.5	628
B. 824	Wheat, Red.....	2	6	97	100	97	24	680
B. 825	Corn, Field.....	2	4	100	100	100	1.5	42
B. 826	Rye.....	2	4	95	84	80	46	1,304
B. 827	Clover, Red.....	1	14	90	95	85	704	19,958
B. 828	Timothy Grass.....	2	7	100	91	91	2,780	78,813
B. 829	Barley.....	1	4	96	85	82	28	794
B. 830	Oats, Red.....	1	7	100	95	95	36	1,021
B. 831	Oats, Black.....	1	7	95	94	89	31	879
B. 832	Oats, White.....	1	5	100	96	96	39	1,105
B. 833	Grass, Tall Oat.....	2	14	100	82	82	330	9,355
B. 834	Wheat, White.....	2	7	100	97	97	30	850
B. 835	Wheat, Red.....	5	11	100	95	95	29	822
B. 837	Rice.....	3	14	100	83	83	40	1,134

TABLE XX.—TESTS OF OLD SEEDS.

Station Numb'r.	Name.	No. of days before first sprout.	No. of days before last sprout.	Vitality, per cent.
B. 717	Sunflower, Small Russian.....	0	0	0.
B. 718	Sunflower, Large Russian.....	4	8	21.
B. 719	Gourd, Southern.....	10	12	20.
B. 720	Pea, Garden.....	0	0	0.
B. 721	Pea, Garden.....	5	5	7.
B. 722	Bean, Large Lima.....	0	0	0.
B. 723	Bean, Marrowfat.....	0	0	0.
B. 727	Soufoin.....	0	0	0.
B. 725	Millet, Golden.....	5	5	1.
B. 726	Millet, Hungarian.....	0	0	0.
B. 727	Clover, Mammoth.....	4.	4.	1.
B. 728	Timothy Grass.....	0.	0.	0.
B. 729	Randall Grass.....	5.	7	2.
B. 730	Rye Grass, Italian.....	5.	5	1.
B. 731	Meadow Foxtail.....	0	0	0.
B. 732	Johnson Grass.....	6	6	1.
B. 733	Castor Oil Bean.....	4	14	5.
B. 734	Oats, Rust Proof.....	3	17	83.
B. 735	Oats, Black.....	4	17	71.
B. 736	Buckwheat, Silverhull.....	0	0.	0.
B. 737	Rice.....	4	8.	13.
B. 738	Barley.....	3	8	14.
B. 739	Cotton.....	0	0	0.
B. 740	Wheat, Flint.....	0	0	0.
B. 741	Wheat, Fultz.....	0	0	0.
B. 742	Wheat, Caldwell's Rust Proof.....	0	0	0.

DISCUSSION OF TABLE XX.—The above samples of seeds were taken from a lot of seeds exhibited by the N. C. Agricultural Department at the State Exposition of 1884, and subsequently at Northern fairs. The seeds were, therefore, six to seven years old. The series is too small to furnish trustworthy data as to the duration of vitality in the species of seeds tested, but the test tends to show that, with the exception of oats, six years is very near the extreme limit. The Station would be glad to receive samples of old seeds of known age for the purpose of enlarging the above series of tests.



ANNUAL REPORT
OF THE
METEOROLOGICAL DIVISION
OF THE
NORTH CAROLINA
Agricultural Experiment Station,
CONSTITUTING
THE N. C. STATE WEATHER SERVICE,
FOR
1889.

H. B. BATTLE, PH. D., DIRECTOR.
C. F. VON HERRMANN, ASSISTANT.

RALEIGH :
EDWARDS & BROUGHTON, POWER PRINTERS AND BINDERS.
1890.

THE NORTH CAROLINA. Agricultural Experiment and Fertilizer Control Station.

ESTABLISHED IN 1877.

HAS FOR ITS SCOPE :

I. Chemical and Microscopical Work, including

1. The analysis of all fertilizers legally on sale in the State.
2. The analysis of agricultural chemicals, of composts, and home-made fertilizers, and all materials from which they can be made.
3. The analysis of soils, marls and mucks
4. The analysis of feeding stuffs.
5. The examination of seeds with reference to their purity, and capacity to germinate.
6. The examination of grasses and weeds
7. The study of insects injurious to vegetation.
8. The analysis of milk, butter and other dairy products.
9. Such other chemical and microscopical investigation as is demanded in the experimental work of the Station

II. Experimental Work in the Field, Stable, and Laboratory, to include

1. The effect of different fertilizers on various soils of the State.
2. The study of improved methods for cultivation of the staple crops.
3. The study of the best treatment for worn-out lands.
4. The study of the best system for the rotation of crops.
5. Chemical investigations, with practical experiments with cattle, on the value of the various forage crops.
6. Investigations on the growth of new crops for this climate, in comparison with those we now have.
7. The construction of the silo, and value of ensilage.
8. The study of the growth of cattle using the different feeding stuffs.
9. Investigations in the production of milk and butter under different conditions, and with various implements.
10. Digestion experiments with stock, to ascertain the value of various food stuffs.
11. Experiment with the various feeding rations to ascertain how far the feeding standards can be relied on.
12. Such other work from time to time as may be deemed advisable for the interests of the agriculture of the State.

III. The Collection and Distribution of Meteorological Data, such as will directly aid the various agricultural industries of the State. The work is expected to be of benefit in

1. A foreknowledge of the coming of cold waves, protecting fruit and tobacco interests.
2. A foreknowledge of the coming of frosts, to benefit the same industries.
3. The distribution to various portions of the State of telegrams giving the probable state of the weather for the succeeding 24 hours.
4. The collection of various meteorological data; and by obtaining a more perfect idea of the various climatic changes, to extend to other localities the crops found useful in portions of this and other States.
5. The collection and distribution of reports showing the effect of the weather on the crops during successive periods of their growth.

IV. A Bureau of Information for all subjects connected with the agricultural industries of the State. Information of this character is always given as promptly and carefully as possible.

V. Miscellaneous Samples. Samples, when sent by citizens of the State, for chemical examination, will be analyzed free of charge—

1. If the experimental work of the Station will not seriously be retarded thereby.
2. If they are of sufficient public interest and the Station is free to publish the results.
3. If the samples are taken and sent according to the Station's printed forms, and are fully described.

VISITORS will be gladly welcomed at

1. Offices, laboratories, and weather station, in the Agricultural Building, one block north of the State Capitol.
2. Farm, experimental stables and dairy, and plant house, on the Hillsboro road, 1½ miles west of the State Capitol, and adjoining the grounds of the State Agricultural Society and of the Agricultural and Mechanical College.

Both the laboratories and the farm have telephonic communication.

Publications will be sent to any address upon application.

Address

Dr. H. B. BATTLE, Director, Raleigh, N. C.

METEOROLOGICAL DIVISION DURING 1889,

EMBRACING THE STATE WEATHER SERVICE.

The Third Annual Summary* of the N. C. State Weather Service contains an account of the work done during the year 1889. The efficiency of the service has been greatly increased during the year, and a valuable mass of meteorological data has been collected, which is indispensable to any one wishing to obtain an accurate knowledge of the climate of the State, of the localities most favorable or unfavorable for the growth of special crops, and to the physician desiring to study the relation of climate to the health of the inhabitants. The object of the service is to observe and utilize every feature of the weather affecting the prosperity of the people.

The work of the service consists—

1st. In the utilization of the cold-wave and frost warnings issued by the general service for the protection of the fruit, trucking and tobacco interests, as well as the distribution of the daily weather indications for the benefit of farmers and others.

2d. The collection and distribution of reports showing the effect of the weather on the growth of the crops at successive periods of their growth.

3d. The collection of various meteorological data, comprising the elements of pressure, temperature, humidity, rain-fall, local storms, etc., mainly statistical, but of great importance and of permanent value.

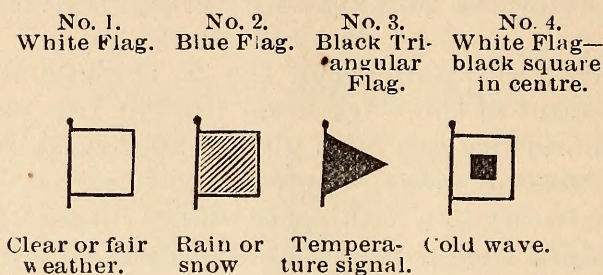
I. SIGNAL DISPLAY STATIONS.

Signal display stations are those displaying flags to indicate the probable state of the weather during the succeeding twenty-four hours, and also to disseminate the knowledge of approaching frosts and cold waves. The forecasts are telegraphed, without expense to the recipient, every day at 8 o'clock A. M., except on Sundays. After the proper flags have been hoisted the telegram is posted on a bulletin board for reference.

Persons desiring to obtain the benefit of the weather indications should make application to the Director. Each display station must be equipped with a set of the flags described below, and a flag staff for displaying them. The displayman who receives the telegram is required to post it, hoist the flags, and note the verification of the signals on a form provided by this office and which is to be rendered monthly. The set of flags, bunting, standard size, cost about six dollars, but an equally serviceable set can be made at home for \$2.00 or \$3.00.

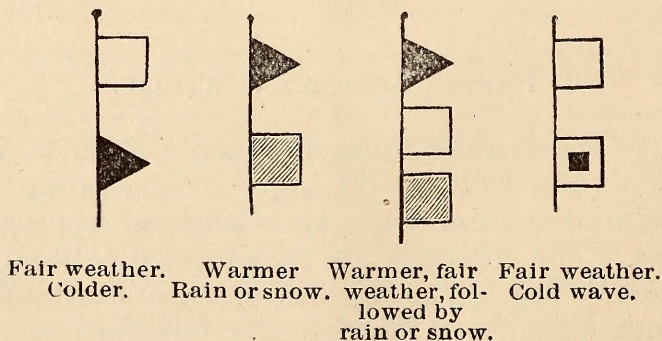
WEATHER SIGNAL FLAGS IN USE DURING 1889.

Hoisted at 8 o'clock A. M. daily (except Sunday), indicates the weather for the twenty-four hours following:



No. 1, white flag, 6 ft. square, clear or fair weather, no rain. No. 2, blue flag, 6 ft. square, rain or snow. No. 3, black triangular flag, 6 ft. at the base and 6 ft. in length, refers to temperature. When placed above Nos. 1 or 2, warmer weather; when placed below Nos. 1 or 2, colder weather; when not displayed, temperature stationary, or that the change in temperature will not vary five degrees of the same hour of the preceding day. No. 4, cold-wave flag, 6 ft. square, the approach of a sudden and decided fall of temperature. This signal is usually ordered at least twenty-four hours in advance of the cold wave. It is not displayed unless a temperature of 45 degrees or less is expected, nor is flag No. 3 displayed with it. The orange rain-flag in use formerly has been discontinued.

EXAMPLES—DISPLAYED FROM POLES.



It is to be regretted that a decrease in the appropriation has limited the funds available to the Chief Signal Officer for telegraphic purposes, so that during the last year many of the stations displaying signals had to be discontinued. The number was reduced to twenty-four; the frost warnings are, however, sent to forty-three additional places. Reference is made to the Annual Report of this Service for 1888 for extracts from letters received in regard to the value of and benefits derived from the forecasts.

The percentage of verifications has been about 83 during the year. In this connection, it may be mentioned that the Chief Signal Officer has recently authorized competent observers to issue local forecasts at certain stations, of which the central office of this Service, at Raleigh, is one. An extension of this system permitting the directors of the State Weather Services to issue forecasts for their respective States, would, it is believed, greatly increase the value and accuracy of the weather indications, since the predicting officer can more easily become familiar with the local peculiarities of a single State than of the country at large. That this will ultimately be done is not improbable.

LIST OF SIGNAL DISPLAY STATIONS OF THE N. C. STATE WEATHER SERVICE IN OPERATION IN 1889.

LOCATION.	COUNTY.	DISPLAYED BY.
1. Blowing Rock	Watauga	H. C. Martin.
2. Burlington	Alamance	J. A. Turrentine.
3. Fayetteville	Cumberland	H. R. Horne.
4. Faison	Duplin	J. S. Westbrook.
5. Gibson	Richmond	W. H. Morrison.
6. High Point	Guilford	Z. F. Hoffman.
7. Lenoir	Caldwell	C. F. Harper.
8. Newbern	Catawba	W. Bavan.
9. Newton	Catawba	E. P. Shrum.
10. Mooresboro	Cleveland	S. S. Royster.
11. Morganton	Burke	P. L. Murphy.
12. Leaksville	Rockingham	J. B. Taylor.
13. Jonesboro	Moore	C. H. Russell.
14. Oak Ridge	Guilford	J. A. Holt.
15. Pineville	Mecklenburg	W. B. Davlin.
16. Pittsboro	Chatham	W. R. Hunter.
17. Raleigh	Wake	J. H. Lawrence.
Raleigh	Wake	Police Department.
18. Statesville	Iredell	J. L. Scales.
19. Shelby	Cleveland	J. T. Gardner.
20. Southern Pines	Moore	H. S. Lloyd.
21. Tarboro	Edgecombe	E. V. Zoeller.
22. Wake Forest	Wake	C. F. Reid.
23. Weldon	Halifax	The Mayor.
24. Washington	Beaufort	J. M. Gallagher.

LIST OF STATIONS TO WHICH SPECIAL FROST WARNINGS ARE SENT.

1. Louisburg.	16. Weldon.	31. Littleton.
2. Macon.	17. Warrenton.	32. Ridgeway.
3. Henderson.	18. Kittrell's.	33. Franklinton.
4. Wake.	19. Grevstone.	34. Neuse.
5. Pittsboro.	20. Carthage.	35. Ghio.
6. Gibson.	21. Cary.	36. Apex.
7. Moncure.	22. Sanford.	37. Cameron.
8. Manly.	23. Keyser.	38. Hamlet.
9. Southern Pines.	24. Aberdeen.	39. Middleburg.
10. Ruffin.	25. Reidsville.	40. Burlington.
11. Mebane.	26. Hillsboro.	41. Chapel Hill.
12. Durham.	27. Clayton.	42. Selma.
13. Princeton.	28. Goldsboro.	43. Greensboro.
14. Jamestown.	29. High Point.	
15. Thomasville.	30. Lexington.	

II. WEEKLY WEATHER CROP BULLETIN.

The Weekly Weather Crop Bulletin was issued during the season of 1889, from May to October, and is one of the features of the State Weather Service work which is highly appreciated by the agricultural interests. The bulletin contains reliable reports from many observers, nearly all of whom are farmers scattered throughout the State, giving the weather conditions for the week and the effect of the same upon growing crops. The reports are mailed to the central office on Friday and form the basis of the weekly bulletin, which is printed and distributed on Saturdays. During the season of 1889 five hundred copies were used every week. The bulletin is sent to all the newspapers and to numerous boards of trade in North Carolina and other States. A summary of the bulletin is also telegraphed each week to the Chief Signal Officer at Washington, where it is used in the preparation of the crop report issued by the general service.

For convenience of reference, a colored map of the State is printed on the back of each bulletin, showing the subdivisions of the State into Eastern, Central, and Western Districts. This division into districts has been made in order to enable the effect of weather on crops to be given in some detail, as the climatic characteristics, geographical features and predominating crops differ in some respects in each district.

LIST OF WEATHER CROP CORRESPONDENTS FOR 1889.

1. EASTERN DISTRICT.

NAME.	LOCATION.	COUNTY.
1. I. Johnston	Littleton	Halifax.
2. W. H. Shields	Scotland Neck	Halifax.
3. T. A. Clarke*	Weldon	Halifax.
4. F. P. Outlaw	Dover	Craven.
5. A. E. Taylor	Burgaw	Pender.
6. W. B. Hocutt*	Rocky Point	Pender.
7. A. J. Davis*	Southport	Brunswick.
8. John Upton	Camden, C. H.	Camden.
9. H. V. Dunston	Windsor	Bertie.
10. J. H. McNeill	Lumberton	Robeson.
11. David Cox*	Hertford	Perquimans.
12. E. V. Zoeller	Tarboro	Edgecombe.
13. Geo. D. Pool*	Elizabeth City	Pasquotank.
14. J. S. Westbrook	Faison	Duplin.
15. Wm. K. Davis	Yorkville	Bladen.
16. W. H. Joiner	Garysburg	Northampton.
17. F. P. Chaffee*	Wilmington	New Hanover.
18. W. J. Crumpler*	Washington	Beaufort.
19. J. H. Gown	Chapanoke	Perquimans.
20. J. W. Haygood	Nashville	Nash.
21. J. F. Newbern	Kingston	Lenoir.

*Supplied with rain-gauges.

2. CENTRAL DISTRICT.

NAME.	LOCATION.	COUNTY.
1. R. J. Noble	Selma	Johnston.
2. W. M. Sanders	Smithfield	Johnston.
3. J. D. Dodd	Clayton	Johnston.
4. W. J. Courts	Reidsville	Rockingham.
5. H. C. Case	Salem	Forsyth.
6. J. W. Upchurch	Thomasville	Davidson.
7. Grimes Bros.	Lexington	Davidson.
8. F. R. Gregory	Sassafras Fork	Granville.
9. W. T. Lyon*	Oxford	Granville.
10. C. F. Reid	Wake Forest	Wake.
11. M. E. Vance	Forestville	Wake.
12. R. A. Cole	Cary	Wake.
13. Observer	Raleigh	Wake.
14. W. G. Egerton	Macon	Warren.
15. P. H. Allen	Warrenton	Warren.
16. W. C. Swann	Pelham	Caswell.
17. D. C. Anderson*	Monroe	Union.
18. J. H. Benton	Beaver Dam	Union.
19. C. C. Townsend	Burlington	Alamance.
20. Jas. B. Huske	Fayetteville	Cumberland.
21. D. W. C. Benbow	Greensboro	Guilford.
22. W. H. Morrison	Gibson Station	Richmond.
23. R. J. Bancombe	Morven	Anson.
24. J. S. Johnson	Spout Springs	Harnett.
25. C. H. Russell	Jonesboro	Moore.
26. O. W. Blacknall	Kittrell	Vance.
27. J. Allen Holt	Oak Ridge	Guilford.
28. Rowland & Parrish	Middleburg	Vance.
29. T. Pool & Bro	Auburn	Wake.
30. W. J. Washburn	Manchester	Cumberland.
31. T. B. Wilder	Louisburg	Franklin.
32. W. I. Everett	Rockingham	Richmond.
33. R. P. McAnnally	Walnut Cove	Stokes.
34. A. O. Hight	Henderson	Vance.
35. S. M. Help	Pittsboro	Chatham.

*Supplied with rain-gauges.

3. WESTERN DISTRICT.

NAME.	LOCATION.	COUNTY.
1. J. W. Mouser	Hickory	Catawba.
2. J. H. Pitts	Catawba	Catawba.
3. J. C. Sandlin	Old Fort	McDowell.
4. E. Pasour*	Dallas	Gaston.
5. P. P. Lorbacher*	Morganton	Burke.
6. J. W. Morrow	Pineville	Mecklenburg.
7. H. P. Helper*	Davidson College	Mecklenburg.
8. B. H. Bronson*	Charlotte	Mecklenburg.
9. H. T. J. Ludwig*	Mt. Pleasant	Cabarrus.
10. J. F. Patterson	China Grove	Rowan.
11. Rendleman & Smith	Iron Station	Lincoln.
12. A. Nixon	Lincolnton	Lincoln.
13. J. H. Tinley*	Bat Cave	Henderson.
14. J. A. Hendrick*	Salisbury	Rowan.
15. J. T. Gardener	Shelby	Cleveland.
16. T. B. Ashby	Mt. Airy	Surry.
17. J. K. Hardwicke	Marshall	Madison.

NAME.	LOCATION.	COUNTY.
18. Eli J. Bradley	Saluda	Polk.
19. E. Everett	Bryson City	Swain.
20. J. W. Cooper	Murphy	Cherokee.
21. J. T. Bingham	Gastonia	Gaston.
22. R. L. Beall*	Lenoir	Caldwell.
23. F. A. Bridges	Grover	Cleveland.
24. B. Everett	Charleston	Swain.

*Supplied with rain-gauges.

The following is a specimen of the Weekly Crop Bulletin:

18TH WEEKLY WEATHER CROP BULLETIN

OF THE

N.C. EXPERIMENT STATION AND STATE WEATHER SERVICE,

CO-OPERATING WITH THE U. S. SIGNAL SERVICE,

FOR THE WEEK ENDING FRIDAY, AUGUST 30TH, 1889.

CENTRAL OFFICE, RALEIGH, N. C.

The reports of correspondents of the Weekly Crop Bulletin, issued by the N. C. Experiment Station and State Weather Service, co-operating with the U. S. Signal Service, show that there has been a slight excess of rain-fall, a deficiency in temperature and very little sunshine during the week ending August 30th. The excess of rain-fall occurring chiefly in the northern part of the State has injuriously affected crops which were beginning to recover from previous excessive rains. In other portions an average rain-fall has been favorable to the growth of most crops. The temperature has been too low with injurious effect, and there has been too little sunshine. There is prospect with a few weeks of fair weather of great improvement in the condition of the *cotton* crop. *Cotton* on stiff soil is reported to be fruiting well. The cutting and curing of *tobacco* is progressing in many localities. The curings are reported bright. The condition of other crops continues very diversified. *Late corn* has been benefitted by the weather during last week. The saving of fodder has been greatly hindered and stopped in some places.

EASTERN DISTRICT.—Reports from this district show some excess of rain-fall in the northern portion and general deficiency of temperature, with little sunshine. Elizabeth City reported 3.50 inches in three days. Weldon 1.27 inches during the week. *Cotton* hindered in northern portion, but showing improvement in other portions of the district. A few weeks of fair weather will greatly improve *low-land cotton*.

CENTRAL DISTRICT.—An excess of rain-fall was reported in a few counties. Gibson Station reports five inches of rain Sunday night, in most, however, about an average amount. Deficiency in temperature and little sunshine. *Tobacco* curings reported bright, but

lacking body. *Cotton* looks well. Weather has prevented saving of fodder. General condition of crops improving.

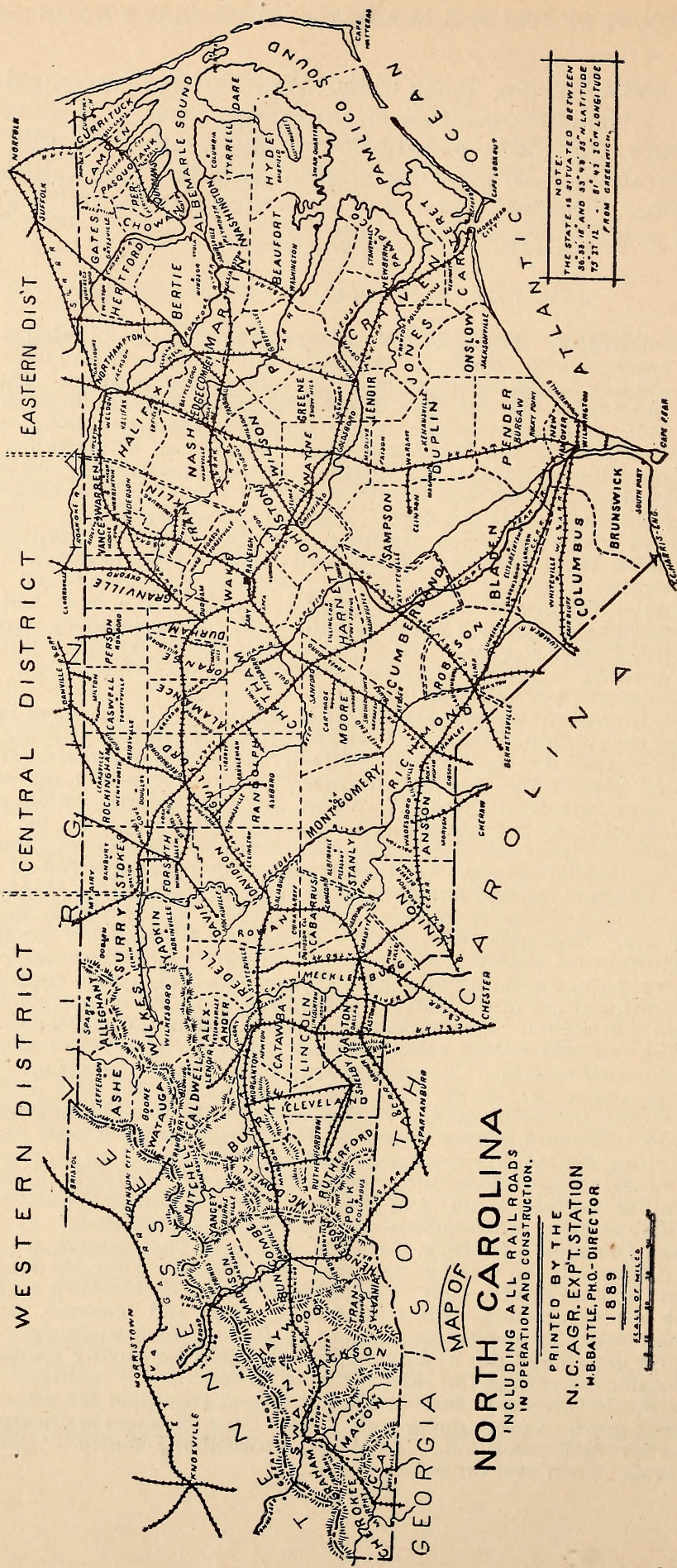
WESTERN DISTRICT.—Condition of the weather in this district very favorable for all growing crops. Rain-fall was a little below the average. *Upland cotton* and *corn* doing very well. Prospects good for average crops of all kinds.

REMARKS OF SPECIAL CORRESPONDENTS.

EASTERN DISTRICT. *Elizabeth City, Pasquotank county*—"Cotton which had begun to recover from effects of excessive rain, is again injured by cool wet weather. Saving fodder interfered with by unfavorable weather. The outlook anything but bright for our hard-worked farmers. Still raining (Thursday)." *Scotland Neck, Halifax county*—"It has rained incessantly during past seven days, with cool North and Northeast winds. Not a day of sunshine, which is injurious to cotton and fodder." *Hertford, Perquimans county*—"It has rained about every day since my last report though very gently. Sunshine only for a few moments during last six days." *Littleton, Halifax county*—"Rather cool the past week with a continued drizzling rain. Scarcely any sunshine. Crops, however, seem to have improved somewhat. Fair to-day (Friday)." *Weldon, Halifax county*—"Rain on six days. Do not think weather of past week has been favorable for cotton." *Dover, Craven county*—"We have had pleasant weather, mostly cloudy, with but little rain, with favorable effect upon crops." *Rocky Point, Pender county*—"All crops have improved very much during recent beautiful growing weather. Peanuts an average crop. Cotton and corn estimated little more than half crop."

CENTRAL DISTRICT. *Beaver Dam, Union county*—"All crops are injuriously affected by the continued rains, and seeding of oats is delayed. Saving of fodder completely stopped for the present." *Sassafras Fork, Granville county*—"Cool weather and heavy rains have greatly interfered with curing tobacco, but late corn has been benefitted thereby." *Selma, Johnston county*—"Cotton fruiting well on stiff land, but not doing much on sandy soil. Has been too damp for saving fodder. Have not had much rain, but has been cloudy and misty." *Smithfield, Johnston county*—"Cotton is still growing and is full of bolls and blooms. With late fall and fair weather the crop will be good." *Macon, Warren county*—"Crops are now doing first rate. Tobacco yellowing on the hill and curing nicely. Highland corn good." *Reidsville, Rockingham county*—"Frequent light showers, plenty of sunshine. Good weather for farmers, for oat sowing, fallowing and for curing tobacco. The curings that I have seen were very pretty, bright, but not much body." *Gibson's Station, Richmond county*—"Too much rain for cotton. Fodder being spoiled." *Pelham, Caswell county*—"Tobacco being cut and curing tolerably well. Rather light and chaffy." *Spout Springs, Harnett county*—"There has been a deficiency in sunshine for the last seven days, and an excess of rain. Land washed terribly, but crops looking well." *Oxford, Granville county*—"The reports still come in that bright curings are the rule." *Monroe, Union county*—"The light rains have been favorable to growing crops and to the sowing of oats and turnips. Low temperature and want of sunshine have been unfavorable for cotton." *Raleigh, Wake county*—"The weather has been cloudy and cool with rain-fall somewhat above the average. Friday clearing, with indications of coming good weather."

WESTERN DISTRICT. *Hickory, Catawba county*—"The farmers are beginning to make fodder, but the weather has been unfavorable. They are done breaking wheat land and are sowing oats." *Davidson College, Mecklenburg county*—"The past week has been cloudy with a little rain. Cool and pleasant. Cotton and corn doing well. Prospects encouraging." *Dallas, Gaston county*—"Too little sunshine for cotton and the weather is not favorable for curing fodder. Conditions favorable for sowing fall oats." *China Grove, Rowan county*—"Have had two days of rain this week, and weather has been favorable for growing crops. Upland corn good. Cotton doing well." *Bat Cave, Henderson county*—"Everything in a favorable condition." *Pineville, Mecklenburg county*—"Cotton a good average crop. Corn over an average crop."



NORTH CAROLINA

INCLUDING ALL RAILROADS
IN OPERATION AND CONSTRUCTION.

PRINTED BY THE
N. C. AGR. EXPT. STATION
W. B. BATTLE, PHO. DIRECTOR
1889



III. COLLECTION OF METEROLOGICAL DATA.

This valuable part of the State Weather Service work has been greatly increased during the year. The number of stations from which reports have been received is forty; of which eleven have been furnished standard instruments under approved bond, and nine are supplied with maximum and minimum thermometers and rain-gauges by this service. Ten are regular Signal Service stations and nine cotton region and special rain-fall stations.

The reports received, embracing barometer readings, temperature, rain-fall, humidity, direction of the wind, state of the weather, and miscellaneous phenomena, are tabulated at the end of each month and published as bulletins of the N. C. Experiment Station. Each monthly bulletin contains, 1, a brief summary of the conditions of the weather during the month; 2, tabulated data, including tables of maximum and minimum temperatures, daily mean temperatures, rainfall, and comparative data for previous years; 3, graphic charts showing the normal and mean temperature isobars for the month, and the distribution of rain-fall. Copies of these reports are sent to the observers of the service, many newspapers, to other weather services in exchange, and any others making application for them.

It is often difficult to find persons willing to spare the time required to make observations and prepare reports, and as the work is done voluntarily, and without compensation, the people of the State are certainly under obligations to the gentlemen who, in the interest of science and agriculture, have, during past years, contributed much time and labor to the earnest support of the State Weather Service.

Sergeant H. McP. Baldwin, Signal Corps, Assistant to the Director, was relieved in August, 1889, and C. F. von Herrmann, Signal Corps, detailed in his place. The Director is also under obligations to the Chief Signal Officer for his hearty co-operation and assistance in many ways.

LIST OF THE METEOROLOGICAL STATIONS OF THE NORTH CAROLINA
STATE WEATHER SERVICE.

EASTERN DISTRICT.

STATION.	COUNTY.	OBSERVER.
1. Clarkton	Bladen	S. Meares.
2. Columbia	Tyrrell	T. L. Jones.
3. Hatteras	Dare	Geo. H. Penrod.*
4. Kitty Hawk	Currituck	Wm. Daily.*
5. Mt. Olive	Wayne	J. B. Oliver.
6. Newbern	Craven	W. G. Boyd.
7. Norfolk, Va	Norfolk	A. J. Davis.*
8. Southport	Brunswick	E. R. Demain.*
9. Washington	Beaufort	Dr. J. M. Gallagher.
10. Weldon	Halifax	T. A. Clark.
11. Wilmington	New Hanover	F. P. Chaffee.*

CENTRAL DISTRICT.

12. Chapel Hill	Orange	Prof. J. W. Gore.
13. Douglas	Rockingham	T. B. Lindsay.
14. Fayetteville	Cumberland	Jas. R. Horne.
15. Louisburg	Franklin	T. J. King.
16. Lynchburg, Va	Campbell	J. N. Ryker.*
17. Monroe	Union	D. C. Anderson.
18. Oak Ridge	Guilford	Prof. J. Allen Holt.
19. Pittsboro	Chatham	Prof. A. McIver.
20. Raleigh	Wake	C. F. von Herrmann.*
21. Smithfield	Johnston	R. D. Lunceford.
22. Southern Pines	Moore	H. W. Lloyd.
23. Winslow	Harnett	J. C. Williams.

WESTERN DISTRICT.

24. Asheville	Buncombe	Dr. Karl von Ruck.
25. Charlotte	Mecklenburg	B. H. Bronson.*
26. Chattanooga, Tenn	Hamilton	L. M. Pindell.*
27. Clear Creek	Cabarrus	H. C. Dunn.
28. Franklin	Macon	Lee Crawford.
29. Highlands	Macon	Prof. T. G. Harbison.
30. Hot Springs	Madison	Dr. W. F. Ross.
31. Knoxville, Tenn	Knox	Henry Pennywitt.*
32. Lenoir	Caldwell	Dr. R. L. Beall.
33. Morganton	Burke	Dr. P. L. Murphy.
34. Mt. Airy	Surry	Jos. W. Ashby.
35. Mt. Pleasant	Cabarrus	Prof. H. T. J. Ludwig.
36. Salisbury	Rowan	John A. Hedrick.
37. Shelby	Cleveland	H. E. Frick.
38. Statesville	Iredell	W. A. Eliason.
39. Marion, Va	Smyth	A. T. Lincoln.
40. Blackman's Mills	Sampson	I. C. Williams.*

*Observers Signal Service.

COTTON REGION AND SPECIAL RAIN-FALL STATIONS.

1. Cheraw, S. C.	4. Lumberton, N. C.	7. Charleston, N. C.
2. Florence, S. C.	5. Wadesboro, N. C.	8. Asheville, N. C.
3. Goldsboro, N. C.	6. Murphy, N. C.	

ANNUAL METEOROLOGICAL SUMMARY FOR NORTH
CAROLINA, YEAR 1889.

GEOGRAPHICAL.

The meteorological conditions tabulated in this summary relate chiefly to the climatic changes in the State of North Carolina and its adjacent territory in the States of Virginia, Tennessee and South Carolina.

North Carolina is included between the parallels $33^{\circ} 49' 55''$ and $36^{\circ} 33' 15''$ north latitude, and between the meridians $75^{\circ} 27' 13''$ and $81^{\circ} 42' 20''$ west longitude. The extreme length of the State from east to west is $503\frac{1}{4}$ miles, the extreme breadth is $187\frac{1}{2}$ miles, and its area embraces 52,286 square miles. The general topography of the land is a vast declivity, sloping from the summits of the Smoky Range Mountains (reaching an altitude of 6,688 feet in the Blue Ridge and embracing the highest land in the United States east of the Rocky Mountains) to the level of the Atlantic Ocean on the east.

The chief meteorological features for the year 1889 are presented in the following tables, which have been compiled from the reports of forty-eight observers. They comprise seven tables, viz:

TABLE I.—Annual summary for the year by months;

TABLE II.—Annual summary of stations having complete or nearly complete records during the year;

TABLE III.—Showing the mean barometer, highest and lowest, for each month of the year at regular Signal Service Stations;

TABLE IV.—Showing the mean temperature, maximum and minimum, for each month of the year;

TABLE V.—Gives the monthly precipitation and number of rainy days;

TABLE VI.—Prevailing wind directions;

TABLE VII.—Table of comparisons for the years 1887, 1888, and 1889.

Miscellaneous data such as snows, frosts, local storms, etc., which could not be placed in tabular form are given below.

TABLE I.--ANNUAL METEOROLOGICAL SUMMARY FOR THE STATE OF NORTH CAROLINA, 1889.

1889.	ATMOSPHERIC PRESSURE (Inches.)										AIR TEMPERATURE. (In Degrees Fahrenheit.)										RELATIVE HUMIDITY. (Per cent.)			PRECIPITATION. (Rain, Snow, Sleet, &c.)				WIND.				WEATHER. (Number of Days.)							
	Normal.	Mean.	Departure.	Absolute Range.			Mean.	Normal.	Departure.	Average.	Normal.	Departure.	Greatest Monthly Total.	Least Monthly Total.	Prevailing Direction.	Average Direction for Many Years.	MAXIMUM VELOCITY.		Direction.	Miles per hour.	Date.	Cloudless.	Partly Cloudy.	Cloudy.	Rainy. †														
				Highst. *	Lowest. †	Date.											Date.	Mean Maximum.								Minimum	Date.	Mean Minimum.	Mean Monthly Range.	Mean Daily Range.	Absolute Range.								
Months.																																							
January	30.09	30.18	— .09	61	23	33	27	1.28	43.2	40.6	+2.4	79	17	52.0	10	22	36.3	42.6	15.7	69	78.4	77.2	+1.2	5.26	5.50	— .24	6.85	2.59	NW.	SW.	48	SW.	17	11	11	8	12	11	
February	30.20	30.14	+ .06	81	24	46	51	1.35	39.6	44.7	— 5.1	72	18	47.8	6	7	31.7	52.0	16.1	66	71.1	70.4	— 0.7	3.72	4.45	— .77	6.60	1.68	NW.	SW.	55	SW.	19	11	8	9	11	8	
March	29.97	30.06	— .09	53	135	19	1.18	48.2	49.1	— 0.9	80	17	57.3	21	10	39.7	45.0	17.6	59	71.7	66.2	— 5.5	2.89	5.50	— 2.61	7.52	0.43	NW.	SW.	84	SW.	19	11	10	10	10	8		
April	29.99	30.01	— .02	50	7	19	26	1.31	59.1	58.1	+1.0	91	22	69.4	24	6	49.6	50.0	19.8	67	68.5	66.3	+2.2	3.63	4.51	— .8	11.87	1.15	N.	SW.	80	SW.	7	11	10	9	10	10	
May	30.01	30.02	— .01	36	5	64	30	0.72	68.3	67.4	+0.7	98	11	78.7	28	4	57.1	52.5	21.6	70	69.9	67.9	+2.0	4.62	3.41	+1.21	8.48	2.54	NW.	SW.	50	SW.	22	15	10	6	9	9	
June	30.08	30.03	— .05	41	24	72	12	0.69	73.4	74.6	— 1.2	98	16	81.7	32	1	64.9	42.1	16.3	66	79.3	71.6	+7.7	5.91	4.48	+1.43	11.91	1.59	SE.	SW.	40	SW.	1	6	10	14	13	13	
July	30.01	30.03	— .01	27	7	77	20	0.50	77.8	78.3	— 1.2	100	10	84.1	51	5	69.2	31.7	14.8	49	81.2	69.7	+11.5	7.73	5.16	+2.57	14.04	2.26	NW.	SW.	52	SW.	1	6	10	13	15	15	
August	30.12	30.02	+ .10	28	20	80	14	0.48	73.5	76.3	— 2.8	96	22	80.5	44	17	65.3	30.2	15.2	52	84.1	74.5	+9.6	5.55	5.61	— .06	11.89	0.77	N.	NE.	40	NE.	26	9	10	12	13	13	
September	30.07	30.09	— .02	43	28	58	20	0.85	68.4	70.1	— 1.7	94	16	76.9	30	27	59.4	44.6	17.5	64	80.0	74.4	+5.6	4.04	4.66	— .62	10.69	0.35	NW.	NE.	48	NW.	10	13	9	8	8	8	
October	30.08	30.11	— .03	10	8	59	27	0.81	57.2	61.6	— 4.4	87	1	67.4	20	8	46.7	57.8	20.7	67	74.4	74.5	— 0.1	2.48	3.78	— 1.30	7.56	0.45	N.	NE.	76	N.	24	15	8	8	5	5	
November	30.13	30.14	— .01	66	16	50	21	1.16	51.8	50.1	+1.7	85	13	60.0	8	29	43.7	42.2	16.4	77	76.8	70.6	+6.2	4.31	4.09	+ .22	6.95	2.18	SW.	NE.	63	SE.	17	11	8	11	10	10	
December	30.24	30.17	+ .07	77	31	76	26	1.01	52.9	42.6	+10.3	78	24	63.0	10	1	42.9	19.1	19.9	66	73.4	73.6	— 0.2	0.59	4.85	— 4.26	1.68	0.10	SW.	SW.	52	NE.	30	14	10	7	3	3	
Annual Means	30.08	30.08	.00	81	24	19	26	1.62	59.4	59.5	— 0.1	100	10	68.2	6	7	50.5	45.0	17.7	94	75.7	71.4	+4.3	50	73	56.00	— 5.27	14.04	0.10	SW.	SW.	84	E.	19	132	112	121	113	113

* In this column supply 30 inches.
 † In this column supply 29 inches.
 ‡ Days on which .01 inch or more of rain fell.

TABLE II. — ANNUAL SUMMARY FOR SEPARATE STATIONS, 1889.

STATIONS.	OBSERVERS.	ATMOSPHERIC PRESSURE. (1)				AIR TEMPERATURE. (2)												Total Precipitation.	Prevailing Wind.	Number of Rainy Days. 5)	Number of Fair Days.	Number of Clear Days.		
		EXTREMES.				EXTREMES.								Mean Monthly Range.	Mean Daily Range.	Mean Humidity.								
		Yearly Mean.	Highest. (3)	Date.	Lowest. (4)	Date.	Range.	Yearly Mean.			Mean Maximum.	Minimum.	Date.				Mean Minimum.						Range.	
								Maximum.	Mean Maximum.	Minimum.														
Asheville.....	Dr. Karl von Ruck.....	30.09	70	Feb. 26	46	Mar. 19	1.24	60.6	91	July 10.	65.8	6	Feb. 7.	44.7	85	50.6	21.1	66.6	37.02	N. & N.W.	121	97	111	157
Charlotte.....	B. H. Bronson *	30.11	66	Dec. 1	43	Jan. 27	1.23	60.4	92	July 12.	70.5	13	Feb. 7.	50.7	83	47.2	19.8	75.4	50.28	N. & S.W.	102	109	113	143
Chattanooga.....	L. M. Pindell *	30.11	66	Dec. 1	43	Jan. 27	1.23	60.4	92	July 12.	70.5	13	Feb. 7.	50.7	83	47.2	19.8	75.4	50.28	N. & S.W.	102	109	113	143
Hatteras.....	Geo. H. Penrod *	30.08	72	Feb. 21	31	Aug. 26	1.41	61.2	87	July 11.	66.0	22	Feb. 7.	56.8	65	30.0	9.2	82.7	67.24	N.	126	104	90	171
Hot Springs.....	Dr. W. F. Ross.....							57.3	90	July 10.				79	46.9									
Kitty Hawk.....	Wm. Daly *							60.3	100	July 10.	69.3	18	Feb. 7.	51.4	82	42.8	17.9							
Knoxville.....	Henry Pennywitt *	30.11	67	Dec. 1	43	Jan. 27	1.24	58.2	92	July 10.	67.5	12	Feb. 7.	43.9	80	46.8	18.6	74.6		N. & S.W.	126			
Lenoir.....	Dr. R. L. Beall.....							56.2	89	May 10.	64.4	8	Feb. 7.	49.2	81	44.1	15.2			N.E.	133	114	131	120
Lynchburg.....	J. N. Ryker *	30.08	81	Feb. 24	36	Jan. 27	1.45	57.2	95	May 11.	66.8	7	Feb. 24.	47.6	88	49.5	19.2	74.6	60.58	N.W.	154	138	142	85
Monroe.....	D. C. Anderson.....							60.8	94	June 21	69.7	16	Feb. 7.	51.7	78	43.7	18.0	78.2	49.93	N.W.	114	151	76	138
Mt. Pleasant.....	H. T. J. Ludwig.....							59.1	91	July 10.	70.1	16	Feb. 7.	48.0	84	50.1	22.1	76.6	50.10	N.W.	92			
Morgan.....	Dr. P. L. Murphy.....							54.8	94	May 10.	63.3	16	Dec. 1.	46.3	78	44.0	17.0	74.0	40.57	S.W.	103			
Norfolk.....	A. J. Davis *	30.06	77	Feb. 24	49	April 26	1.56	59.1	98	July 11.	66.7	16	Feb. 24.	51.5	82	43.2	15.2	77.2	70.72	S.S.	156	147	119	99
Raleigh.....	C. F. von Herrmann *	30.07	76	Feb. 24	44	Jan. 27	1.32	59.4	94	July 10.	69.2	20	Feb. 25.	54.8	74	38.7	14.4	76.0	48.38	S.S.	130	132	100	133
Salisbury.....	J. A. Hedrick.....							62.0	94	July 10.	69.2	20	Feb. 25.	54.8	74	38.7	14.4	76.0	48.38	S.S.	93			
Southport.....	E. R. Demain *							62.6	91	July 10.	69.2	20	Feb. 7.	56.0	71	36.8	13.2			S.W.	119	104	95	166
Weldon.....	T. A. Clark.....							58.8	96	June 11.	71.1	11	Feb. 24.	50.4	85	48.9	20.7			S.	123			
Wilmington.....	F. P. Chaffee *	30.07	61	Feb. 21	40	Mar. 19	1.21	62.8	97	May 11.	70.7	20	Feb. 7.	54.9	77	40.2	15.8	80.8	59.31	S.W.	138	114	111	140

(1) Reduced to sea-level. In inches and hundredths. (2) Degrees Fahrenheit. (3) Supply 30 inches. (4) Supply 29 inches. (5) Days on which .01 inch or more of rain fell. * Observers Signal Service. † Ten months only. ‡ Eleven months only. § Also on May 10th and July 11th.

TABLE III.—MEAN BAROMETER, HIGHEST AND LOWEST, 1889.
(Barometer-readings reduced to sea-level. In inches.)

STATIONS.	JANUARY.			FEBRUARY			MARCH.			APRIL.			MAY.			JUNE.			JULY.			AUGUST.			SEPTEMBER			OCTOBER.			NOVEMBER			DECEMBER.			* Annual Average.
	Mean Bar.	Highest. *	Lowest. **	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.	Mean.	Highest.	Lowest.							
Charlotte	30.09	54.51	30.19	70.55	30.00	50.46	30.00	40.56	30.00	30.74	30.09	36.81	30.04	25.79	30.14	28.90	30.08	38.69	30.09	33.69	30.14	30.16	59.52	30.24	67.97	.09											
Chattanooga..	30.11	46.43	30.22	64.67	30.00	36.47	30.02	43.71	30.04	35.64	30.06	30.83	30.04	25.84	30.14	27.96	30.10	42.76	30.14	40.76	30.16	56.54	30.26	66.03	.11												
Hatteras	30.09	60.46	30.18	72.59	29.94	48.35	29.96	42.31	30.01	31.76	30.11	36.76	30.06	25.82	30.12	27.92	30.05	34.70	30.05	33.73	30.14	60.61	30.24	61.82	.08												
Lynchburg	30.08	59.36	30.20	81.59	29.96	53.53	29.99	43.43	29.99	33.73	30.08	33.73	30.08	41.76	30.02	26.77	30.12	35.58	30.08	34.59	30.12	65.50	30.21	77.78	.08												
Knoxville.....	30.12	49.43	30.23	67.62	30.02	38.48	30.04	50.68	30.05	36.70	30.09	34.86	30.04	27.83	30.14	28.92	30.10	43.75	30.14	40.78	30.15	57.56	30.25	67.01	.11												
Norfolk	30.07	61.33	30.18	77.46	29.93	53.45	29.95	46.19	29.99	35.76	30.07	37.72	30.02	26.77	30.11	26.82	30.03	33.62	30.05	34.64	30.12	66.51	30.22	70.76	.06												
Raleigh.....	30.08	58.44	30.20	76.56	29.96	53.52	29.97	40.42	29.98	29.72	30.07	33.74	30.02	23.79	30.10	25.84	30.05	33.66	30.07	31.59	30.12	59.52	30.23	67.90	.07												
Wilmington ..	30.08	54.52	30.19	61.57	29.94	49.40	29.97	35.47	29.99	26.75	30.09	32.74	30.04	22.83	30.11	24.88	30.05	32.70	30.06	30.70	30.13	54.57	30.24	59.91	.07												
Means	30.09	61.33	30.20	81.46	29.97	53.35	29.99	50.19	30.01	36.64	30.08	41.72	30.04	27.77	30.12	28.80	30.07	43.58	30.08	40.59	30.13	66.50	30.24	77.76	.08												

* In columns "Highest" supply 30 inches.

** In columns "Lowest" supply 29 inches.

TABLE IV.—MEAN TEMPERATURES, MAXIMUM AND MINIMUM, FOR EACH MONTH OF THE YEAR 1889.
(Expressed in Degrees Fahrenheit.)

	JANU'RY			FEBU'RY			MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPT.			OCTOBER			NOV.			DEC.			YEARLY.
	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.				
Eastern District.																																					
Clarkton.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Goldsboro.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Hatteras.....	47.6	65.32	43.6	67.22	47.1	63.35	56.4	69.38	.....	.....	.....	.....	70.9	95.41	76.4	94.54	78.8	98.62	76.5	90.53	69.9	88.46	58.1	87.30	52.6	85.20	.....	.....	.....	.....	.....	.....	.....	.....	.....
Kitty Hawk.....	49.0	70.29	41.2	69.18	47.0	74.80	57.6	82.41	68.5	94.46	75.3	98.54	78.1	100.61	76.6	96.62	79.6	98.62	75.6	90.58	70.8	90.41	81.32	51.6	82.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lumberton.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
N. riok, Va.....	44.4	67.24	38.2	71.16	45.0	70.29	56.8	89.36	68.1	93.46	73.9	94.55	77.6	98.63	74.4	90.61	68.4	88.46	57.7	91.40	68.4	88.46	57.7	91.40	53.4	78.27	51.5	74.28	.....	.....	.....	.....	.....	.....	.....	.....
Newbern.....	48.0	79.20	44.0	68.13	49.0	70.29	59.5	73.40	70.0	87.44	76.2	92.50	77.2	94.58	74.6	90.58	69.5	86.42	62.6	81.40	56.8	75.26	54.0	78.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southport.....	49.4	65.17	44.6	61.20	50.1	70.29	59.5	73.40	70.0	87.44	76.2	92.50	77.2	94.58	74.6	90.58	69.5	86.42	62.6	81.40	56.8	75.26	54.0	78.26	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Weldon.....	43.0	68.17	38.8	66.11	46.0	74.24	57.7	88.32	67.4	93.39	73.9	96.50	77.8	96.59	74.1	90.56	67.9	87.42	57.6	81.32	51.8	78.24	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Washington.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilmington.....	50.1	69.29	44.4	67.20	51.9	72.33	60.6	86.42	70.9	97.45	75.5	93.58	79.0	94.66	76.0	87.63	71.8	87.48	60.9	83.37	56.8	78.27	56.0	76.30	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Means*	47.4	79.17	42.0	71.11	48.1	77.24	58.3	89.32	69.0	97.39	74.6	98.50	78.2	100.58	75.4	96.53	70.2	92.41	59.6	87.30	55.1	85.20	53.4	78.20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Central District.																																					
Cheraw, S. C.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Chapel Hill.....	46.6	70.20	37.9	68.10	47.4	74.27	58.9	90.33	68.8	97.38	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Douglas.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Florence, S. C.....	35.0	65.30	.....	.....	54.0	70.38	.....	.....	74.9	98.43	77.6	96.50	81.6	100.64	77.0	92.60	73.0	90.48	60.8	81.36	56.4	80.34	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Fayetteville.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Lynchburg, Va.....	41.2	69.18	34.8	66.7	46.7	77.28	57.0	89.28	66.0	93.55	71.7	92.45	76.2	96.59	72.4	89.53	66.7	87.42	54.4	81.33	48.3	73.21	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Louisburg.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Monroe.....	45.1	68.22	40.9	67.16	49.7	73.28	62.4	85.36	69.9	93.41	74.8	94.51	78.9	93.66	73.8	86.57	69.4	86.44	58.0	82.35	52.4	78.22	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Pittsboro.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Raleigh.....	41.2	68.21	38.2	68.13	47.2	74.27	58.3	89.32	68.2	94.40	73.6	98.49	77.5	95.62	73.4	90.56	68.7	87.42	57.6	82.34	52.3	80.24	53.4	75.25	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Southern Pines.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Soapstone Mt.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Smithfield.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wake Forest.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wadesboro.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Winslow.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Means*	42.4	70.18	39.2	72.7	48.6	77.25	59.3	91.28	70.6	98.34	75.4	98.45	77.4	100.59	73.7	91.33	69.0	94.40	57.9	86.32	51.7	82.13	53.7	76.14	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....

TABLE IV.—MEAN TEMPERATURES, MAXIMUM AND MINIMUM, FOR EACH MONTH OF THE YEAR.—CONTINUED.

	JANU'RY			FEB'U'RY			MARCH			APRIL			MAY			JUNE			JULY			AUGUST			SEPT.			OCT.			NOV.			DEC.			YEARLY.
	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.				
Asheville.....	38.6	60 13	36.3	70 6	45.6	73 21	55.9	83 28	62.7	89 30	68.2	90 37	73.6	91 57	69.2	83 50	64.1	82 36	52.6	78 27	46.2	72 15	51.2	72 16	55.4												
Clear Creek.....																																					
Charlotte.....	44.1	70 22	39.4	69 13	51.0	75 28	61.2	86 38	70.4	95 38	73.4	91 45	78.8	96 61	74.0	90 55	70.1	84 44	58.8	78 34	47.4	70 18	51.2	73 18	60.6												
Chattanooga, T.	42.6	64 20	41.7	71 13	51.6	80 26	62.2	86 37	66.2	91 41	72.2	87 39	78.4	92 63	74.8	91 57	69.1	89 40	58.4	82 35	50.1	73 23	51.7	76 27	60.4												
Franklin.....																																					
Grover.....																																					
Hot Springs.....	41.1	60 17	38.4	69 11	47.5	76 27	63.7	88 33	68.7	94 41	73.2	87 46	78.2	90 69	71.4	84 60	74.8	84 36	51.2	77 20	44.7	70 11	47.6	72 12													
Highlands.....																																					
Knoxville, T.....	40.8	65 20	38.8	64 12	48.6	77 26	59.6	83 32	64.4	91 36	70.7	88 44	77.2	92 60	73.2	86 56	67.5	89 40	55.4	80 30	47.8	74 21	54.1	72 22	58.2												
Lenoir.....	38.1	60 14	35.9	62 8	47.3	67 27	58.7	85 30	63.9	89 35	69.5	81 43	74.0	87 63	70.4	82 56	65.9	83 40	51.0	77 30	47.2	71 23	48.9	70 19	56.2												
Mt. Pleasant.....	42.7	70 17	37.9	66 10	48.4	74 23	59.8	88 32	68.0	94 34	73.2	92 45	77.7	94 62	73.2	89 56	68.4	88 38	57.0	82 29	50.8	80 19	52.0	76 20	59.1												
Marion, Va.....	31.8	60 10	31.0	62 6	41.6	72 22	52.5	80 24	58.5	88 28	66.0	89 40	73.3	91 51	69.0	85 49	64.0	88 38	51.0	77 30	44.2	72 18	47.0	67 13													
Morganton.....																																					
Mt. Airy.....																																					
Statesville.....	40.0	64 20	36.9	67 12	48.6	72 28	60.0	86 36	63.6	92 36	72.7	91 45	77.6	93 66	74.6	88 58	68.4	86 42	53.1	76 26	46.3	72 20	50.4	73 16	51.8												
Salisbury.....	44.4	67 30	41.2	67 20	52.7	69 32	62.5	85 41	72.5	93 45	77.2	91 62	81.2	94 71	76.4	87 63	71.4	87 46	58.2	78 36	52.0	73 24	54.6	72 29	62.0												
Means*.....	40.7	70 10	38.2	71 6	48.2	80 21	59.6	88 24	65.7	95 28	70.6	94 32	76.2	96 51	72.0	91 44	67.3	89 30	57.4	82 20	47.8	80 8	51.6	76 10	57.9												
Average for State	43.2	79 10	39.6	72 6	48.2	80 21	59.1	91 24	68.3	98 28	73.4	98 32	77.1	100 51	73.5	96 44	68.4	91 30	57.2	87 20	51.8	85 8	52.9	78 0	59.4												

* Highest and lowest are given of maximum and minimum columns.

TABLE V.—MONTHLY PRECIPITATION AND NUMBER OF RAINY DAYS, YEAR 1889.
(Including rain, snow, hail, sleet, etc. Expressed in inches and hundredths.)

STATIONS.	JAN.	FEB.	MAR.	APRIL.	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTALS.	AVER- AGES.	No. Months
Clarkton.....	6.82	11 4.52	8 5.43	9 10.08	12 6.03	10 11.91	14 2.26	16 5.20	9 1.70	2 4.55	5 4.70	12 0.26	11.45	3.82	3
Hatteras.....	5.59	13 2.82	10 3.52	10 9.56	15 4.70	13 7.82	7.30	3.83	14 4.84	8 2.80	3 3.05	12 0.30	67.24	5.60	12
Kitty Hawk.....	4.88	9 4.21	9 7.52	11 11.87	15 4.58	13 6.80	8.65	6.89	18 3.30	1 1.34	3 3.51	10 0.30	50.41	4.69	7
Lumberton.....	5.80	2.65	2.90	...	6.12	13 6.41	15 10.69	20 5.93	17 5.58	12 7.56	11 2.53	4 0.77	32.62	4.66	7
Norfolk, Va.....	6.18	10 3.11	12 5.01	9 2.04	13 3.04	8 6.62	15 6.22	18 3.78	20 5.41	17 3.16	5 2.18	1 0.30	70.72	5.89	12
Newbern.....	4.62	8 3.53	7 3.87	12 6.59	12 8.48	14 8.82	14 8.59	16 3.54	17 3.26	9 3.39	6 2.61	7 0.80	45.06	4.14	10
Southport.....	6.85	10 4.66	10 5.57	11 2.13	11 4.24	9 6.03	11 10.99	13 9.40	14 3.18	8 3.87	7 3.72	12 0.15	58.15	3.75	12
Weldon.....	5.82	10 3.73	9 4.83	10 6.53	13 4.85	10 7.37	12 7.97	17 6.65	16 3.29	9 3.74	7 3.61	10 0.38	40.68	5.81	7
Washington.....	...	...	...	...	...	...	...	...	...	...	...	...	59.31	4.94	12
Wilmington.....	...	...	...	...	...	...	...	...	...	...	...	...	46.35	4.84	...
Means.....	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Cheraw, S. C.....	6.71	4.24	2.33	...	3.79	4.57	10.89	10.01	3.95	3.14	3.78	...	40.13	5.73	7
Chapel Hill.....	...	...	...	...	6.02	...	...	6.96	...	3.35	3.23	3 0.46	30.09	3.76	8
Fayetteville.....	...	...	...	...	3.52	5.03	11 14.04	20 6.51	15 3.68	10 2.46	...	...	35.00	5.43	6
Florence, S. C.....	...	...	...	...	5.64	4.31	...	11.89	1.46	...	4.11	...	35.76	5.11	7
Louisburg.....	...	...	...	...	...	...	4.81	10 4.81	...	...	2.90	6 0.51	7.71	3.86	2
Lynchburg, Va.....	5.26	12 3.06	11 2.44	11 3.14	13 7.14	14 3.82	19 10.94	18 3.82	12 10.69	12 4.90	9 4.86	15 0.64	60.58	5.05	12
Monroe.....	6.00	13 3.71	7 2.74	7 1.78	8 3.11	4 6.97	14 6.51	17 4.34	12 5.93	9 2.69	7 5.48	12 0.64	49.93	4.16	12
Pittsboro.....	...	...	...	...	...	4.38	8.50	11 4.70	12 2.50	8 3.10	3 4.30	6 0.40	27.88	3.98	7
Raleigh.....	6.02	13 3.36	8 2.72	9 4.01	12 5.30	12 10.44	9 6.08	18 8.74	19 1.68	7 3.41	8 3.07	11 0.60	55.39	4.62	12
Soapstone Mt.....	...	...	...	...	...	3.75	10.00	6.25	4.12	3.00	5.50	...	32.62	5.41	6
Southern Pines.....	...	3.65	3.65	5.56	5.00	3.90	...	...	2.50	4.00	4.20	1 0.03	33.46	3.72	9
Smithfield.....	...	...	...	...	...	...	9.96	5.60	7 3.80	8 2.00	3.60	...	14.40	3.60	4
Wadesboro.....	...	...	...	...	4.18	4.75	...	9.73	0.85	1.20	3.25	...	33.94	4.85	7
Wake Forest.....	...	2.25	4 3.23	7 4.34	6 3.91	10 4.75	...	...	...	...	...	...	13.73	3.43	4
Winslow.....	...	...	...	...	...	...	...	...	...	...	...	...	13.05	2.61	5
Means.....	6.00	13 3.38	8 2.85	8 3.48	10 4.76	10 5.19	13 8.76	16 6.88	12 3.76	9 2.93	3 2.80	7 0.70	32.24	4.38	...

* Number of days on which .01 inch or more of rain fell.

TABLE V.—MONTHLY PRECIPITATION AND NUMBER OF RAINY DAYS, YEAR 1889.—CONTINUED.

STATIONS.	JAN.	FEB.	MAR.	APRIL	MAY.	JUNE.	JULY.	AUG.	SEPT.	OCT.	NOV.	DEC.	TOTALS.	AVER- AGES.	No Months.
Asheville (1).....	3.45	1.42	1.28	1.15	5.29	4.51	5.81	5.46	3.89	0.46	5.06	0.98	88.76	3.23	12
Asheville (2).....	2.59	1.68	0.43	1.45	7 5.47	4.77	4.39	5.81	4.28	0.49	4.72	0.97	37.05	3.09	12
Charleston.....	4.77	3.80	1.84	1.74	3.47	3.79	6.56	8.01	3.56	0.82	5.39	1.50	45.25	3.77	12
Clear Creek.....							8.20	4.38	5.10	2.70	3 5.40	0.35	26.13	4.36	6
Charlotte.....	6.15	4.59	7 1.62	2.60	9 2.75	4 10.54	15 8.17	13 4.53	11 2.88	6 1.53	4 4.44	10 0.48	50.28	4.19	12
Chattanooga.....	5.31	5.10	6 3.71	3.21	8 4.59	10 4.16	19 3.33	14 3.77	18 7.87	14 1.38	8 6.44	19 0.44	49.31	4.11	12
Franklin.....							5.35	3.10	4.75	0.45	3 4.50	7 0.90	19.05	3.18	6
Grover.....					0.30	1.59	3.60	0.77	0.35				6.61	1.32	5
Highlands.....						3.78		4.33	8.90	0.80	5 6.38	9 1.35	25.54	4.26	6
Knoxville.....	3.88	5.82	7 2.08	1.92	10 4.08	9 5.57	17 2.85	14 6.42	13 5.74	11 1.81	7 6.58	15 0.98	47.73	3.98	12
Lenoir.....	3.50	2.40	7 1.20	2.20	5 6.60	7 5.90	12 9.00	17 4.20	13 5.30	7 0.70	2 6.40	11 0.50	47.90	3.99	12
Morgan.....		2.58		2.17		4.29	11 6.97	17 4.00	12 4.89	6 0.50	2 6.95	9 0.45	40.57	3.69	11
Mt. Airy.....				3.41	5.10	4.53	8 10.38	11 5.14	11 5.01	6 1.16	4 4.48	10 0.92	40.13	4.46	9
Mt. Pleasant.....	6.06	3.77	6 2.15	2.77	8 2.90	4 6.02	14 8.26	16 4.51	10 3.95	8 3.15	5 5.95	8 0.60	50.10	4.18	12
Maion, Va.....	2.77	3.46	1.52	2.18	8.24	7.38	7.65	3.91	11 3.50	3.50	3.47	12 1.68	48.97	4.08	12
Mt. Holly.....	6.17	3.86	2.00	2.40	2.56	7.91	7.84	2.80		2.75	4.67		46.43	4.13	11
Murphy.....	6.01	5.71	2.35	2.33	3.75	6.48	7.11	6.09	3.93	2.16	6.75	1.53	54.20	4.52	12
Statesville.....	4.90	6.60	2.14	2.78	3.11	6.20	12 13.61	19 7.90	16 4.78	7			52.02	5.78	9
Salisbury.....	5.90	7 3.33	6 3.30	7 2.85	8 3.01	7 5.57	11 7.25	14 6.13	12 3.40	6 2.18	5 4.96	9 0.50	48.38	4.03	12
Means.....	4.73	10 3.87	7 1.94	7 2.34	8 4.21	7 5.47	14 7.02	14 4.80	12 4.50	8 1.56	4 5.44	11 0.88	40.76	3.91	3
Averages for State.....	5.26	11 3.72	8 2.89	8 3.63	10 4.62	9 5.91	13 7.73	15 5.55	8 4.04	8 2.48	5 4.31	10 0.59		4.24	3

Western District.

TABLE VI.—PREVAILING WIND DIRECTIONS FOR THE YEAR 1889.

STATIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Asheville	---	---	---	{ N. NW.	{ N. NW.	S.	{ N. NW.	SE.	{ N. NW.	N.	{ N. NW.	{ N. NW.	{ N. NW.
Charlotte	{ N. NE. NW.	SW.	W.	W.	{ N. NW. SE. W.	S.	S.	NE.	NW.	N.	SW.	SW.	SW.
Chattanooga	---	NW.	NW.	W.	---	NE.	W.	NW.	NW.	N.	SW.	S.	NW.
Franklin	---	---	---	---	---	---	S.	S.	S.	S.	NE.	S.	S.
Hatteras	N.	N.	NW.	{ N. SW.	N.	S.	S.	NE.	NE.	N.	NE.	SW.	N.
Knoxville	E.	W.	NE.	W.	W.	SW.	SW.	NE.	NE.	NE.	NE.	SW.	NE.
Kitty Hawk	NE.	NE.	N.	SW.	NE.	SW.	SW.	SW.	SW.	SW.	SW.	NE.	SW.
Lynchburg	NW.	NW.	NW.	NW.	NW.	NW.	S.	S.	N.	N.	{ NE. NW.	N.	NW.
Morganton	---	---	---	---	---	W.	SW.	SW.	SW.	NW.	SW.	W.	SW.
Mt. Airy	---	---	---	---	---	SW.	SW.	SW.	SW.	SW.	SW.	SW.	SW.
Mt. Pleasant	NW.	NE.	NW.	SW.	SW.	SW.	SW.	SW.	SW.	NW.	SW.	SW.	SW.
Monroe	{ NE. NW.	NW.	NW.	NW.	NW.	SW.	SE.	{ SW. NE.	NW.	NW.	SW.	SW.	NW.
Norfolk	SW.	N.	NW.	SE.	NW.	S.	SW.	SW.	NW.	NW.	SW.	SW.	SW.
Pittsboro	---	---	---	---	---	---	---	---	---	---	---	---	---
Raleigh	NW.	NW.	NW.	NW.	N.	S.	SW.	SW.	W.	N.	SW.	SW.	SW.
Southport	W.	{ N. SW.	NE.	SW.	SW.	SW.	SW.	SW.	SE.	N.	NE.	SW.	SW.
Weldon	NW.	W.	W.	S.	S.	S.	S.	S.	S.	N.	S.	S.	S.
Wilmington	NE.	SW.	N.	SW.	SW.	SW.	SW.	SW.	N.	N.	NE.	SW.	SW.
Averages	NW.	NW.	NW.	SW.	{ N. NW.	SW.	SW.	SW.	NW.	N.	SW.	SW.	SW.

TABLE VII.—TABLE OF COMPARISONS FOR THE YEARS 1887, 1888 AND 1889.

DATA.	1887.	1888.	1889.	NORMALS AND EXTREMES.
Annual Mean Barometer.....	30.07 inches	30.09 inches	30.08 inches	Normal: 30.09 inches.
Highest Barometer.....	30.853 at Chapel Hill on February 5th	30.790 inches at Lynchburg, Va., on Jan. 12th	30.81 inches at Lynchburg, Va., on Feb. 24th	
Lowest Barometer.....	29.140 at Hatteras on August 20th	29.220 inches at Norfolk, Va., on December 17th	29.19 inches at Norfolk, Va., on April 26th	
Range.....	1.71 inches	1.57 inches	1.62 inches	
Annual Mean Temperature.....	59.1 degrees	59.0 degrees	59.4 degrees	Normal: 59.5 degrees. Highest on record: 107.1 at Kitty Hawk in 1887. Lowest on record: 16 below zero in Jan. 1884, Knoxville Absolute range 123. Mean for three years: 55.03. Normal: 71.4 per cent. Normal: 56.00 inches.
Highest Temperature.....	107.1 on July 18th at Kitty Hawk	104 degrees July 9th at Cheraw, S. C.	100 degrees July 10th at Kitty Hawk	
Lowest Temperature.....	4 below zero Jan. 6th at Salem, Forsyth Co., NC	6 degrees in January at Asheville, N. C.	6 degrees February 7th at Asheville, N. C.	
Range.....	111 degrees	98 degrees	94 degrees	
Monthly Range.....	61.3 degrees	59.6	45.0	Normal: 4.67 inches.
Mean Humidity.....	73.3 per cent	76.2 per cent	75.7 per cent	
Average Precipitation.....	49.37 inches	54.14 inches	50.73 inches	
Greatest Monthly Rain-fall.....	22.73 inches, August at Tarboro, N. C.	12.90 inches in September at Salisbury, N. C.	14.04 inches in July at Fayetteville, N. C.	
Average Monthly Rain-fall.....	4.11 inches	4.53 inches	4.24 inches	Normal: 4.67 inches.
Greatest Yearly Rain-fall.....	10.6	60.85 at Southport	70.72 inches at Norfolk	
Aver. No. clear days per m'th.....	11.5	11.1	11.0	
Aver. No. fair days per m'th.....	8.3	9.7	9.3	
Aver. No. clo'dy days per m'th.....	10.4	9.8	10.1	Normal direction SW.
Aver. No. rainy days per m'th.....	SW	9.4	9.4	
Prevailing wind.....	SW	SW	SW	

EXPLANATION OF THE TABLES.—Pressure.—The monthly mean pressure has been obtained during the year by dividing the sum of the average pressures at 8 A. M. and 8 P. M. by two. The annual mean pressure is obtained by dividing the sum of the mean pressures for each month by twelve. For the sake of convenience the whole number of inches in the barometric tables have been omitted where it could be done without ambiguity. A note indicates in which columns respectively to supply “30” or “29” inches.

The normal pressure is obtained by taking the sum of the mean monthly pressures for many years and dividing by the number of years taken. The pressure normals for this State for the year 1889 have been calculated from the records of seven Signal Service stations, and cover a period of fifteen years. It is not probable that these numbers will have to be changed for many years. The following are the normals as used in this report. In every column “30” is omitted before the decimal point.

PRESSURE NORMALS.

STATIONS.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	YEAR.
Charlotte .....	.18	.15	.05	.01	.02	.03	.03	.02	.09	.11	.14	.17	.08
Chattanooga .....	.19	.15	.08	.02	.02	.04	.04	.03	.09	.13	.16	.19	.10
Hatteras .....	.16	.13	.04	.00	.03	.03	.03	.02	.07	.09	.11	.14	.07
Knoxville .....	.20	.16	.09	.02	.03	.03	.05	.04	.10	.14	.18	.20	.10
Lynchburg .....	.17	.14	.05	.00	.01	.02	.00	.03	.09	.11	.14	.16	.08
Norfolk .....	.16	.14	.04	.00	.02	.02	.01	.02	.09	.11	.12	.14	.07
Wilmington .....	.17	.14	.05	.01	.02	.03	.03	.02	.07	.10	.13	.16	.08
For the State .....	.18	.14	.06	.01	.02	.03	.03	.02	.09	.11	.14	.17	.08

Temperature.—At a number of volunteer stations observations of temperature are taken at 7 A. M., 2 P. M. and 9 P. M., and a very accurate mean is obtained by dividing the sum of the 7 A. M., 2 P. M. and twice the 9 P. M. observation by four. For stations which report only maximum and minimum temperatures a tolerably accurate mean has been obtained by dividing the sum of the average maximum and minimum temperatures by two. The latter method is now used by the Signal Service at all its regular stations.

The temperature normals have been calculated from commencement of observations to the year 1884. As temperature is the most important of all meteorological elements, these normals have been made as accurate as possible. For 1890 normals will be used covering the period of nineteen years from 1871 to 1889, inclusive.

Following are the normals used in this report (in degrees Fahrenheit):

TEMPERATURE NORMALS.

STATIONS.	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	YEAR.
Charlotte	40	46	50	59	69	75	79	76	71	62	50	42	60
Chattanooga	41	45	51	60	68	75	78	76	70	62	49	42	60
Hatteras	44	47	49	56	66	74	78	77	74	66	56	47	61
Knoxville	37	42	48	58	67	73	76	75	69	58	46	39	57
Lynchburg	36	40	45	56	66	74	78	75	69	58	46	38	57
Norfolk	40	43	47	56	67	75	79	77	71	61	50	42	59
Wilmington	46	50	54	62	70	76	80	78	73	64	54	48	63
For the State	40.6	44.7	49.1	58.1	67.6	74.6	78.3	76.3	70.1	61.6	50.1	42.6	59.5

Precipitation.—This includes rain, melted snow, sleet or hail. An inch of unmelted snow is equivalent to one-tenth of an inch of rainfall. The averages to be used during 1890 will also be calculated for nineteen years, 1871 to 1889, inclusive.

Weather.—The state of the weather at any time is determined from the amount of clouds observed. The weather is clear when the sky is three-tenths, or less than three-tenths, covered with clouds; fair when the sky is from four to seven-tenths (both inclusive) covered; cloudy when the sky is more than seven-tenths covered. Thus a day would be considered clear if the average amount of clouds observed during the day did not exceed three tenths, fair if it did not exceed seven-tenths, cloudy if the average amount of clouds observed was eight-tenths or more. The sum of the clear, fair and cloudy days must make up the total number of days of the month or of the year. A rainy day is one on which .01 inch or more of precipitation has fallen, and has nothing to do with the amount of clouds observed.

Table VII presents some interesting comparisons for the previous three years, as also normals and extremes for many years. The very small variation of the annual mean temperature for the State of North Carolina during the years 1887, 1888, 1889, is worthy of note. An increase, or a decrease, of more than a few degrees in this mean would probably indicate a serious change in the climate of the State.

GENERAL REMARKS.

The year 1889 was characterized by an unusual number of destructive storms and floods. The most remarkable of these were the great storm of January 8th to 10th, which caused great loss of life and property in Pennsylvania and New York; the Johnstown flood, caused by the storm of May 30th, 31st, and June 1st; and the St.

Thomas-Hatteras Hurricane of September 3d to 12th, 1889. The extent to which these storms affected the weather in this State is shown below under "Miscellaneous Phenomena," where are recorded the most important local storms occurring during the year.

During the summer months of the year 1889 the temperature was decidedly below the average, while the rain-fall was in excess. But the winter of '89 and '90 will probably go on record as one of the mildest ever experienced in the State; trees and flowers continued to bud and bloom to the end of the year; in January, '90, in parts of the State, strawberries have been picked and shipped, and blackberries were in blossom.

The mean pressure for the year was 30.08 inches, the same as the normal pressure. Also the annual mean temperature only differed by -0.1 of a degree from the normal. The mean temperature for 1887 was 59.1 degrees, for 1888, 59.0, for 1889, 59.4 degrees. The average precipitation for the year was 50.73 inches, as compared with 54.14 inches in 1888, and 49.37 inches in 1887. The prevailing wind direction was southwest. The last killing frost of the winter of '88 and '89 occurred May 4th, 1889, but light frosts also occurred May 23d, and even June 1st, 1889. The first light frost of the winter of '89 and '90 occurred September 19th, 1889; the first killing frost generally over the State on the 7th and 8th of October, 1889. The average date of the first killing frost in the State is October 10th. The first flurries of snow occurred at Asheville, October 14th. The precipitation for the winter months is below the average.

Pressure.—The highest barometer observed during the year was 30.81 inches, at Lynchburg, Va., on February 24th. The lowest was 29.19 inches, at Norfolk, Va., on April 26th. This low pressure occurred during the development of a separate storm on the North Carolina coast from a trough of low pressure, the center of which was north of the lower lakes. The storm is described on page 82, *Monthly Weather Review* for April. The barometer did not fall so low while the St. Thomas-Hatteras hurricane was off the coast of North Carolina, though the pressure at the center of the cyclone, a few hundred miles out at sea, was extraordinarily low, about 28.50 inches. The absolute range in barometer for the State was 1.62 inches.

Temperature.—The annual mean temperature for the year, 59.4 degrees, is about the average. The highest yearly mean temperature, 62.8 degrees, occurred at Wilmington, N. C. This is .2 of a degree lower than the highest yearly mean, which occurred in 1888. The lowest yearly mean temperature was 54.8 degrees, at Morganton (record for 11 months only); next lowest 55.4, at Asheville. It is probable, judging from partial records, that Highlands, N. C., has the lowest annual temperature of any station reporting to the State Weather Service. The highest mean monthly temperature was 81.6 degrees, at Florence, S. C.; within the State, 81.2 degrees, at Salisbury,

in July. The lowest mean monthly temperature was 31.0 degrees, at Marion, Va., in February; within the State, 35.9 degrees, at Lenoir, in February. The highest actual temperature was 100 degrees, at Florence, S. C., and Kitty Hawk, on July 10th. The lowest was 6 degrees, at Asheville, on February 7th. Range of temperature, 94 degrees. The highest temperature ever before recorded was 107.1 degrees, at Kitty Hawk, on July 18th, 1887; the lowest ever before recorded was 16 degrees below zero, at Knoxville, Tenn., in 1884.

Relative Humidity.—Annual mean, 75.7 per cent., which is 4.3 per cent. above the normal. The highest monthly mean relative humidity occurred in August. The highest yearly mean was 82.7 per cent., at Hatteras; the lowest was 66.6 per cent., at Asheville.

Precipitation.—The monthly average rain-fall, as given in Table V, shows that the rain-fall was differently distributed and somewhat less than during the preceding year. The year 1889 may be divided into three periods of four months each. During the first period the rain-fall was deficient; during the next, which includes the months of May, June, July and August, the rain-fall was considerably above the average; again, during the last period, there was comparatively little rain-fall. The excess in precipitation, as shown by this table, outside of the destruction caused by merely local storms and floods, as, for instance, that at Lumberton, on May 14th (see page 32), does not seem to constitute by itself sufficient explanation of the cause of the partial failure of the cotton crop in this State during 1889. Table V must be studied in connection with the temperature deficiencies during the corresponding months, which probably had nearly as much effect in retarding the growth of cotton during June, July, August and September as the excess of rain-fall had.*

Considering the monthly averages (lowest line of Table V), it will be seen that the least rain-fall occurred in December, with an average of only 0.59, which was 4.26 inches below the normal. The next lowest average was 2.89 inches in March, which was 2.61 inches below the normal. The heaviest rain-fall occurred in July, average 7.73 inches, which was 2.75 above the normal. The largest yearly total (only stations having complete or nearly complete records considered) was 70.72 inches, at Norfolk, Va. Hatteras follows with 67.24 inches. In 1889 the following stations reported rain-falls of ten inches or over:

April—Hatteras	10.18 inches.
“ Norfolk, Va	11.87 “
June—Charlotte	10.54 “
“ Hatteras	11.91 “
“ Raleigh	10.44 “

*For an excellent statement of the meteorological conditions most favorable to the growth of the cotton plant, see Bulletin No. 7, New Series II, October, 1889, of the South Carolina Agricultural Experiment Station.

July—Cheraw, S. C	10.89 inches.
“ Fayetteville	14.04 “
“ Lynchburg, Va	10.94 “
“ Mt. Airy	10.38 “
“ Norfolk, Va	10.69 “
“ Soapstone Mount	10.00 “
“ Statesville	13.61 “
“ Washington	10.99 “
“ Wilmington	11.10 “
August—Cheraw, S. C	10.01 “
“ Florence, S. C	11.89 “
September—Lynchburg, Va	10.69 “

The greatest monthly rain-fall was 14.04 inches, at Fayetteville, in July. The least was 0.10 inches, at Southport, in December. The monthly mean for the year, calculated from data covering the whole State, is 4.24 inches. The largest number of rainy days occurred in June, July and August; the least in December.

Wind.—Prevailing direction, southwest. The highest velocities reported each month were as follows:

January, 1889—Highest velocity, 48 miles from the southwest on the 17th, and 48 miles from the northeast on the 19th, at Kitty Hawk.

February.—Highest velocity, 55 miles from the northeast, at Kitty Hawk, on the 10th.

March—Highest velocity, 84 miles from the east, at Kitty Hawk, on the 19th.

April—Highest velocity, 80 miles from the north, at Hatteras and Kitty Hawk, on the 7th.

May—Highest velocity, 50 miles from the west, at Norfolk, and 50 miles from the northwest, at Hatteras and Kitty Hawk, on the 22d.

June—Highest velocity, 40 miles from the southeast, at Hatteras, on the 1st.

July—Highest velocity, 52 miles from the northwest, at Norfolk, on the 11th.

August—Highest velocity, 40 miles from the northeast, at Kitty Hawk, on the 26th.

September—Highest velocity, 48 miles from the northwest, at Norfolk, on the 10th.

October—Highest velocity, 76 miles from the north, at Hatteras, on the 24th.

November—Highest velocity, 63 miles from the southeast, at Southport, on the 17th.

December—Highest velocity, 52 miles from the northeast, at Kitty Hawk, on the 30th.

See also description of local storms.

MISCELLANEOUS PHENOMENA.

*January, 1889.**Thunder-storms.*—No thunder-storms occurred during the month.*Snow.*—Asheville, on the 28th; Lenoir, 2 inches on the 20th; Mt. Pleasant, Monroe and Salisbury, on the 28th.*Sleet.*—Mt. Pleasant, on the 19th; Salisbury, on the 20th.*Frosts.*—Frosts occurred on the following dates: 1st to 8th, inclusive; 10th to 15th, inclusive; 19th to 23d; 27th to 31st.*Solar Halos.*—Hatteras, 10th and 12th; Mt. Pleasant, 9th, 11th, 15th and 18th.*Lunar Halos.*—Hatteras, 9th, 10th, 11th and 12th; Mt. Pleasant, 11th.*Rains over one inch.*—Charlotte, 1.24 inch on 25th, 1.27 inch on 20th, 1.06 inch on 27th; Chattanooga, 1.22 inch on 16th; Hatteras, 1.86 inch on 5th, 1.52 inch on 27th; Kitty Hawk, 1.48 inch on 5th, 1.25 inch on 27th; Lenoir, 1.10 inch on 16th to 17th; Mt. Pleasant, 1.62 inch on 4th to 5th, 1.25 inches on 20th, 1.81 inch on 25th to 26th; Monroe, 1.41 inch on 4th, 1.02 inch on 20th, 1.20 inch on 26th; Norfolk, 1.70 inch on 27th; Raleigh, 1.75 inch on 5th, 1.15 inch on 20th, 1.05 inch on 27th; Southport, 1.20 inch on 5th; Salisbury, 1.55 inch on 5th, 1.38 inch on 20th, 1.32 inch on 25th to 27th; Wilmington, 1.90 inch on 5th, 1.03 inch on 20th.*Local Storms.*—Hatteras 21st, storm began from the southwest at 2.55 A. M. and ended at 3.10 A. M.; maximum velocity of the wind, thirty-five miles per hour. The Life-Saving Station at Cape Hatteras reports five men drowned, one barkentine and one three-masted schooner sunk, and other vessels disabled on Hatteras shoal during the gale. (M. W. R.) **February.**Thunder-storms* —Hatteras, Monroe and Raleigh, on 17th; Lenoir and Weldon, on 18th; Mt. Pleasant and Salisbury, on 17th and 18th.*Snow.*—Asheville, 6th, 11th, 21st and 22d; Lenoir, 1 inch on the 11th, 2.5 inches on the 22d; Mt. Pleasant, 0.1 inch on the 11th, 11 inches on the 21st to 22d; Monroe, 1.15 inch on the 10th, 11 inches on the 21st; Raleigh, 10.3 inches on 11th, 21st and 22d; Salisbury, 0.2 inch on the 11th, 8 inches on the 22d; Weldon, on the 11th, 3.5 inches on the 22d; Wake Forest, 8 inches*Frosts.*—Asheville, 1st to 14th, 18th to 28th; Charlotte, 1st, 2d, 3d, 4th, 6th to 13th, 15th, 16th, 19th to 27th; Hatteras, 7th to 24th; Kitty Hawk, 1st to 8th, 12th, 13th 24th to 26th; Lenoir, 1st to 8th, 10th to 13th, 20th, 21st, 23d to 27th; Mt. Pleasant, 2d, 3d, 4th, 7th,

*Monthly Weather Review of the Signal Service.

8th, 12th, 13th; Monroe, 1st, 2d, 6th, 7th, 8th, 10th to 13th, 23d to 26th; Norfolk, 2d, 3d, 6th, 7th, 8th, 11th, 12th, 13th, 20th, 23d to 26th; Raleigh, 1st, 2d, 3d, 4th, 6th, 7th, 8th, 11th, 12th, 13th, 20th, 24th to 28th; Southport, 7th, 8th, 10th, 12th, 13th; Weldon, 1st to 4th, 6th to 8th, 10th to 14th, 20th to 26th; Wilmington, 6th, 7th, 8th, 24th, 25th.

Solar Halos.—Mt. Pleasant, 12th, 23d, 25th.

Lunar Halos.—Mt. Pleasant, Raleigh and Weldon, on the 9th.

Rains over one inch.—Charlotte, 1.38 inch on 16th; Chattanooga, 1.96 inch on 15th, 2.18 inches on 16th; Hatteras, 1.87 inch on 22d; Mt. Pleasant, 3.05 inches on 15th to 18th; Monroe, 1.05 inch on 15th, 1.39 inch on 17th; Norfolk, 1.11 inch on 16th, 1.77 inch on 18th; Raleigh, 1.15 inch on 16th, 1.40 inch on 22d; Salisbury, 1.25 inch on 26th, 1.27 inch on 18th; Weldon, 1.22 inch on 17th, 1.23 inch on 18th, 1.02 inch on 22d; Wilmington, 1.22 inch on 17th, 1.04 inch on 22d.

Local Storms.—Wilmington, 18th, a high northwest gale began at 9:10 A. M. and ended at 1:45 P. M.; maximum velocity of wind, thirty-six miles per hour at 12:10 P. M. Several trees and one frame building were blown down. (M. W. R.)*

March.

Thunder-storms.—Hatteras, 19th, 25th; Mt. Pleasant, 18th, 24th; Raleigh, 25th; Wilmington, 19th.

Frosts.—Asheville, 4th to 13th, 23d, 26th, 28th, 29th; Charlotte, 29th; Hatteras, 12th; Kitty Hawk, 9th, 10th, 11th; Lenoir, 10th, 26th, 29th; Mt. Pleasant, 4th, 6th, 7th, 8th, 9th, 11th, 12th, 17th, 21st, 26th, 29th, 30th; Monroe, 10th, 11th, 22d, 29th; Norfolk, 10th, 11th; Raleigh, 1st, 2d, 6th, 7th, 8th, 9th, 10th, 11th, 12th, 13th, 23d, 29th; Southport, 10th, 11th; Salisbury, 4th, 6th, 21st, 22d, 23d, 29th; Weldon, 4th, 10th, 11th, 12th, 23d, 29th.

Solar Halos.—Mt. Pleasant, 29th.

Lunar Halos.—Mt. Pleasant, 11th, 12th, 13th; Monroe, 12th; Weldon, 13th.

Rains over one inch.—Chattanooga, 1.59 inch on 19th; Hatteras, 1.22 inch on 15th, 1.60 inch on 19th; Norfolk, 1.38 inch on 3d, 2.50 inches on 15th, 1.15 inch on 19th, 1.51 inch on 20th; Southport, 1.57 inch on 14th, 1.07 inch on 19th; Salisbury, 2.00 inches on 18th to 19th; Weldon, 1.16 inch on 2d to 3d, 1.52 inch on 18th to 20th; Wilmington, 1.60 inch on 14th, 2.18 inches on 19th.

Local Storms.—Wilmington, 19th, the hail and thunder-storm in the evening was very severe in the northern section of the city. At the Wilmington Compress building nearly all the glass in the skylights was broken, and the hail drifted in places to a depth of twelve inches; the hail also caused much damage to plants and shrubbery.

Beyond the city limits north and west the storm was still more severe. At Navassa Guano Works one hundred and fifty panes of glass were broken and the drifts were three feet deep. (*The Morning Star*, Wilmington, March 21st.)

April.

Thunder-storms.—Asheville, 13th, 27th; Chattanooga, 12th, 13th, 24th; Hatteras, 6th; Mt. Pleasant, 13th, 28th; Monroe, 13th, 27th, 28th; Raleigh, 6th; Weldon, 6th, 28th.

Hail.—Asheville, 28th; Chattanooga, 12th; Weldon, 6th.

Frosts.—Asheville, 6th, 7th, 8th; Charlotte, 8th; Chattanooga, 26th; Lenoir, 7th, 8th, 29th; Mt. Pleasant, 8th, 9th; Monroe, Raleigh and Weldon, 9th.

Solar Halos.—Chattanooga, 22d.

Lunar Halos.—Chattanooga, 10th; Mt. Pleasant and Weldon, 12th.

Rains over one inch.—Chattanooga, 1.63 inch on 14th; Hatteras, 1.11 inch on 6th, 3.84 inches on 15th, 2.12 inches on 25th; Kitty Hawk, 1.30 inch on 7th, 2.50 inches on 15th, 1.65 inch on 16th, 1.05 inch on 25th and 26th; Lenoir, 1.10 inch on 14th to 15th; Mt. Pleasant, 1.15 inch on 14th to 16th, 1.22 inch on 25th; Norfolk, 1.53 inch on 6th, 2.20 inches on 7th, 1.52 inch on 15th, 4.60 inches on 16th; Raleigh, 1.19 inch on 15th; Southern Pines, 1.05 inch on 26th; Salisbury, 1.23 inch on 25th; Weldon, 1.53 inch on 6th to 7th, 2.48 inches on 14th to 17th, 2.48 inches on 25th to 27th.

Local Storms.—Raleigh, 6th to 7th; brisk wind from the south began at 7:30 A. M. 6th, and increased in force until 1 A. M. 7th, when the maximum velocity forty-five miles per hour was recorded. Light snow fell from 4:30 P. M. to 9:30 P. M. 6th.

Kitty Hawk, 7th: A severe storm accompanied by heavy rain began 5 A. M. The wind increased in force and attained a velocity of eighty miles an hour from the north at 10:30 A. M. The sea washed over the beach and around the buildings of the Signal office and Life-Saving Station, the water being knee deep between the buildings. Telegraphic communication was cut off, as was also the telephone communication north. Several fishing crafts and other sailing vessels are reported wrecked. Reports from Nags Head, Dare County, state that the storm was very destructive in that section; two large houses were washed away or blown into the sound, and all the bath-houses were washed down and strewn over the beach; over sixty head of cattle were drowned between that point and Oregon Inlet, and the Oregon Inlet cable was washed away.

Hatteras, 7th: A severe storm set in at 7 A. M. and continued throughout the day, the wind attained a maximum velocity of eighty miles per hour from the north at 6:22 P. M. Several vessels were blown ashore, and one, the "Nellie Potter," of Washington,

N. C., became a total loss. High tide submerged Hatteras Island and water entered many houses. Trees were uprooted, fences demolished and gardens ruined. It is stated that this tide was the highest that has occurred since Hatteras Inlet was cut out in 1846. (M. W. R.)*

May.

Thunder-storms.—Asheville, 19th; Charlotte, 1st, 13th, 30th; Chattanooga, 1st, 12th, 13th, 20th, 29th; Lenoir, 28th; Mt. Pleasant, 13th, 30th; Monroe, 13th, 30th; Raleigh, 14th, 22d, 26th; Salisbury, 1st, 14th, 25th, 26th; Weldon, 21st, 26th; Washington, 11th, 12th, 13th, 14th, 20th, 21st, 22d, 27th; Wilmington, 1st, 22d, 27th, 30th.

Hail.—Lenoir, 14th; Salisbury, 26th; Weldon, 21st, 25th; Washington, 11th, 12th, 13th, 26th, 27th.

Frosts.—Asheville, 3d, 4th; Charlotte, 4th, 23d; Chattanooga, 4th, 5th; Lenoir, 3d, 4th, 5th, 23d; Mt. Pleasant, 3d, 4th, 23d; Raleigh, 4th, 5th; Weldon, 4th; Wake Forest, 4th, 5th, 23d.

Solar Halos.—Chattanooga, 10th.

Lunar Halos.—Charlotte, 11th, 12th; Chattanooga, 9th; Washington, 11th.

Rains over one inch.—Asheville, 9:15 P. M. on 29th to 4:15 P. M. on 30th, 4.18 inches; Charlotte, 1.44 inch on 30th; Hatteras, 1.54 inch on 20th, 3.06 inches on 28th; Lenoir, 4.10 inches on 29th to 30th; Mt. Pleasant, 2.09 inches on 30th; Monroe, 2.04 inches on 30th; Norfolk, 1.06 inch on 27th; Raleigh, 2.79 inches on 29th to 30th; Southport, 1.35 inch on 19th; Salisbury, 1.58 inch on 30th; Weldon, 1.43 inch on 20th, 1.16 inch on 21st, 4.44 inches on 30th to 31st; Washington, 3.52 inches on 19th to 20th; Wilmington, 1.38 inch on 19th.

Local Storms.—Grover, Cleveland County, 1st: A cloud rose in the northwest at 5 P. M.; it suddenly turned very dark and appeared like smoke rising from a huge oil-tank on fire; a yellowish cloud followed closely after, accompanied by heavy rain, hail and high wind, unroofing and destroying houses, leveling fences, and blowing down timber and orchards in this section. The path of the storm was about one-half mile wide and six miles long.—(Report of F. H. Dover.)

Wilmington, 1st: Reports from Warsaw, Duplin County, a small town fifty miles north of this city, state that that place was visited at 4 P. M. by a terrific storm from the southeast, accompanied by rain, hail, and high wind, lasting but one or two minutes. Hail fell from four to six inches in depth, and for the very short duration of the wind an almost incredible amount of damage is reported. One church and twenty houses were blown down, and of the church only the pulpit and one chair was left on the site. The estimated damage to cattle, property and crops, was between \$15,000 and \$20,000.

Kitty Hawk, 14th: At 8 p. m. the wind shifted suddenly from southwest to northwest, with a velocity of forty-five miles per hour for ten minutes, accompanied by a light rain. A violent hail-storm is reported seven to nine miles north of this place, breaking a large number of window-panes in residences; several trees were blown down and fences damaged. Six iron poles on the coast line in the track of the storm were broken off, as was also the wire.

Wilmington, 14th: Reports from Magnolia, Duplin County, and from Lumberton, Robeson County, state that a severe hail-storm passed over those places between 4 and 5 p. m. The storm approached from the west and was accompanied by terrific west to northwest winds. Large hail-stones fell to a depth of from one to three inches. At Lumberton two houses were blown down and one unroofed. Most of the cotton crop in the section visited by the storm will have to be replanted, as it is almost a total loss.

Charlotte, 30th: High wind began 11:30 A. M. and continued until 6:15 p. m. from the southeast and south. Maximum velocity thirty-four miles per hour from the southeast. Heavy rain began about noon and continued at intervals through the day, at times very heavy. Many fruit trees were blown down and other minor damage done in this city. A large tobacco warehouse was blown down at Danville, near this city; five persons were killed and several seriously wounded. Small grain, which was ready for harvesting, was considerably injured by the heavy rain and high wind. (M. W. R.)*

June.

Thunder-storms.—Asheville, 30th; Charlotte, 9th, 10th, 16th, 19th, 30th; Chattanooga, 9th, 10th, 13th, 14th, 15th, 16th, 18th, 19th, 20th, 21st, 27th, 28th, 30th; Hatteras, 5th; Lenoir, 24th; Morganton, 9th, 10th, 15th; Mt. Airy, 9th, 10th; Mt. Pleasant, 9th, 10th, 13th, 30th; Monroe, 9th, 10th, 13th, 18th, 19th, 21st, 28th, 29th, 30th; Raleigh, 9th; Statesville, 9th, 10th, 11th, 30th; Weldon, 4th, 9th, 21st; Washington, 2d, 3d, 21st; Wilmington, 4th, 5th.

Frosts.—Chattanooga, Lenoir, Mt. Pleasant, Statesville on the 1st.

Solar Halos.—Statesville, 2d, 17th; Weldon, 2d, 17th.

Lunar Halos.—Chattanooga, 7th, 9th; Mt. Pleasant, 9th, 11th; Weldon, 2d.

Meteors.—Louisburg, 26th; Lenoir, 4th; Washington, 26th.

Rains over one inch.—Asheville, 2.15 A. M. to 3.35 P. M., 1.43 inch on 28th; Charlotte, 1.09 inch on 9th, 1.35 inch on 25th, 1.36 inch on 28th, 2.39 inches on 29th, 2.75 inches on 30th; Fayetteville, 2.30 inches on 28th; Hatteras, 1.88 inch on 1st, 1.30 inch on 3d, 2.07 inches on 18th, 1.34 inch on 24th, 1.20 inch on 26th, 1.64 inch on 28th; Kitty Hawk, 2.33 inches on 1st, 1.03 inch on 26th, 1.25 inch on 27th; Lenoir, 2.20 inches on 24th to 25th; Morganton, 1.86 inch on 25th; Mt. Airy, 1.09 inch on 13th, 1.35 inch on 29th; Mt.

Pleasant, 1.04 inch on 24th to 25th, 2.44 inches on 28th to 29th; Monroe, 1.56 inch on 28th, 1.05 inch on 29th, 1.04 inch on 30th; Norfolk, 1.20 inch on 5th; Raleigh, 2.28 inches on 9th, 1.10 inch on 24th to 25th, 2.46 inches on 28th, 2.77 inches on 30th; greatest amount, 5.18 inches on 28th to 29th; Southern Pines, 1.10 inch on 25th to 29th; Southport, 1.90 inch on 24th; Statesville, 1.25 inch on 24th to 25th, 1.25 inch on 28th; Salisbury, 1.22 inch on 24th to 25th, 1.92 inch on 28th, 1.18 inch on 30th; Weldon, 2.00 inches on 9th, 1.26 inch on 21st, 2.87 inches on 28th to 29th; Washington, 1.60 inch on 21st, 1.10 inch on 25th to 26th, 3.33 inches on 28th to 29th; Wilmington, 1.15 inch on 5th, 1.46 inch on 24th, 1.25 inch on 25th.

Local Storms.—Pittsboro, 25th: About 3 P. M. there was a tornado one-fourth mile west of this place moving from south to north, with heavy rain, about three miles wide. (Reported by Alex. McIver.)

July.

Thunder-storms.—Charlotte, 2d, 10th, 11th, 12th, 13th, 19th, 20th, 21st, 26th, 27th; Clarkton, 1st, 4th, 12th, 13th, 14th, 15th, 20th, 21st, 22d, 26th, 27th, 28th, 31st; Hatteras, 12th, 13th, 15th, 20th, 26th; Morganton, 5th; Mt. Airy, 13th, 16th, 24th, 25th, 27th, 30th, 31st; Mt. Pleasant, 13th, 21st, 25th, 26th, 27th, 31st; Monroe, 4th, 12th, 14th, 15th, 19th, 21st, 25th, 26th, 27th, 28th, 30th, 31st; Pittsboro, 18th, 28th; Raleigh, 11th, 13th, 26th, 27th, 31st; Statesville, 11th, 19th, 31st; Washington, 3d, 4th, 10th, 12th, 13th, 15th, 20th, 23d, 24th, 25th, 26th, 29th, 30th, 31st.

Hail.—Lenoir, 11th.

Rains over one inch.—Asheville, 5 P. M. to 9 P. M. 1.88 inch on 25th; Charlotte, 2.40 inches on 26th, 2.46 inches on 27th; Clarkton, 1.05 inch on 5th, also on 12th, 16th, 23d; Clear Creek, 1.55 inch on 25th, 2.75 inches on 26th, 1.47 inch on 27th; Fayetteville, 1.07 inch on 15th, 1.16 inch on 18th, 3.84 inches on 27th, 1.68 inch on 31st; Franklin, 1.50 inch on 31st; Louisburg, 0.90 inch in 20 minutes on 31st; Lenoir, 1.80 inch on 2d, 1.40 inch on 26th, 1.40 inch on 27th; Morganton, 2.38 inches on 30th, 1.10 inch on 31st; Mt. Airy, 1.50 inch on 13th, 1.18 inch on 27th, 2.50 inches on 30th, 2.79 inches on 31st; Mt. Pleasant, 3.21 inches on 25th, 1.53 inch on 26th, 1.29 inch on 31st; Monroe, 1.70 inch on 30th; Norfolk, 2.04 inches on 4th, 2.34 inches on 25th, 1.19 inch on 27th; Pittsboro, 2.65 inches on 18th, 1.45 inch on 28th; Southport, 1.52 inch on 5th, 1.37 inch on 27th; Statesville, 2.78 inches on 2d to 4th, 1.24 inch on 18th to 19th, 2.92 inches on 24th to 26th, 4.56 inches on 30th to 31st; Salisbury, 1.42 inch on 20th, 1.15 inch on 25th, 1.44 inch on 26th; Weldon, 1.25 inch on 21st, 1.26 inch on 4th, 1.45 inch on 28th, 1.08 inch on 31st; Washington, 1.40 inch on 3d, 1.96 inch on 4th, 2.38 inches on

12th, 1.44 inch on 25th; Wilmington, 3.32 inches on 1st, 1.23 inch on 24th, 1.43 inch on 27th.

Local Storms.—Mt. Airy, 30th: the rain on the 30th to 31st did more damage in this section than any ever known here. The water-courses were swollen out of their banks, and many mills were entirely washed away. About twenty miles of the Cape Fear and Yadkin Valley Railroad was washed out.—(Reported by J. W. Ashby).

Wilmington, 1st: A severe thunder-storm, passing from southwest to northeast, accompanied by vivid and incessant lightning, began at 11:45 A. M. and ended 1:50 P. M. The drainage being insufficient to carry off the water, several houses on Market and Front streets were flooded.

Wilmington, 25th: It is reported from Taylor's Bridge, Sampson County, that the heaviest rain ever known in that place occurred between 6:30 A. M. and 9 P. M. Three mills were carried away. Estimated damage, \$3,000. (M. W. R.)*

August.

Thunder-storms.—Asheville, 1st, 4th, 5th, 22d, 23d, 25th; Charlotte, 6th; Chattanooga, 2d, 3d, 4th, 13th, 14th, 22d, 24th, 26th, 28th; Clarkton, 1st, 2d, 3d, 4th, 5th, 6th, 11th; Hatteras, 3d, 15th; Lenoir, 4th; Morganton, 2d, 3d, 4th, 23d; Mt. Pleasant, 1st, 4th, 5th, 6th; Monroe, 1st, 2d, 3d, 4th, 5th, 6th, 11th, 23d; Raleigh, 23d; Statesville, 1st, 2d, 3d, 4th, 6th, 22d, 23d; Washington, 1st, 2d, 3d, 23d.

Solar Halos.—Washington, 3d, 22d.

Lunar Halos.—Charlotte, 5th; Washington, 1st, 3d, 23d, 27th.

Meteors—Washington, 11th.

Rains over one inch.—Asheville, 1.59 inch on 22d; Charlotte, 1.45 inch on 5th, 1.22 inch on 7th; Clarkton, 2.50 inches on 27th; Clear Creek, 1.15 inch on 5th, 1.35 inch on 7th; Fayetteville, 1.54 inch on 7th; Hatteras, 2.87 inches on 3d; Kitty Hawk, 1.25 inch on 2d; Lynchburg, 1.27 inch on 5th, 1.38 inch on 28th; Morganton, 1.04 inch on 1st; Norfolk, 1.47 inch on 11th; Raleigh, 2.15 inches on 5th, 1.64 inch on 7th, 1.02 inch on 23d, 1.08 inch on 27th; Statesville, 1.14 inch on 4th to 5th, 2.58 inches on 27th to 28th; Southport, 1.72 inch on 26th; Salisbury, 1.34 inch on 6th, 1.59 inch on 27th; Winslow, 2.00 inches on 27th; Washington, 2.29 inches on 3d, 1.72 inch on 6th, 1.95 inch on 7th; Wilmington, 1.80 inch on 2d, 1.13 inch on 3d, 1.32 inch on 26th.

Local Storms.—Soapstone Mountain, 1st: A severe thunder and rain storm passed over this place between 4:20 P. M. and 5:30 P. M. In this section several persons were shocked, and one person was killed, by lightning.—(Reported by Mr. H. T. Kimrey.)

Rockingham, 26th: A cloud-burst occurred over this city and vicinity during the day, destroying the dams and machinery of

several mills. The loss is estimated at \$100,000.—*Morning Herald*, Baltimore, Md. (M. W. R.)*

Bat Cave, Henderson County, 2d to 9th: The rain-fall for the last seven days has been very great. A cloud-burst occurred in the eastern portion of the county which far surpassed the experience of the oldest citizens, but happening to fall in that section of the mountains where our little streams are high and fast flowing, there was no serious damage done to the crops. (John H. Tinley).

September.

Thunder-storms.—Chattanooga, 5th, 10th; Hatteras, 14th, 18th; Raleigh, 15th.

Frcsts.—Asheville, 20th, 22d, 28th; Charlotte, 20th; Chattanooga, 28th; Clarkton, 19th; Franklin, 19th, 20th, 29th; Highlands, 19th, 21st, 27th; Hot Springs 21st, 29th; Lenoir, 20th, 22d, 28th; Lynchburg, 27th; Raleigh, 22d; Statesville, 19th, 20th, 22d, 28th; Salisbury, 20th, 21st, 22d; Winslow, 22d.

Solar Halos.—Statesville, 20th, 23d.

Lunar Halos.—Chattanooga, 4th; Morganton, 4th.

Rains over one inch.—Asheville, 1.06 inch on 24th; Charlotte, 1.30 inch on 24th; Chattanooga, 2.02 inches on 5th, 1.92 inch on 17th, 1.06 inch on 23d; Clear Creek, 1.50 inch on 6th, 1.85 inch on 25th; Fayetteville, 1.19 inch on 5th, 1.22 inch on 15th, 2.21 inches on 26th; Franklin, 2.00 inches on 23d; Hatteras, 3.48 inches on 18th; Highlands, 3.20 inches on 18th to 19th, 1.13 inch on 16th, 1.95 inch on 5th; Lenoir, 1.60 inch on 6th to 7th, 1.30 inch on 17th, 2.00 inches on 23d to 24th; Lynchburg, 1.20 inch on 7th, 3.30 inches on 15th, 1.10 inch on 17th, 2.87 inches on 24th, rain-fall heaviest since 1871; Morganton, 1.15 inch on 6th, 2.00 inches on 23d to 24th; Mt. Airy, 1.40 inch on 17th, 2.03 inches on 24th; Mt. Pleasant, 1.63 inch on 23d to 24th; Monroe, 1.57 inch on 6th, 1.33 inch on 14th, 1.76 inch on 23d; Norfolk, 1.05 inch on 13th, 1.40 inch on 18th; Southern Pines, 2.00 inches on 24th; Statesville, 2.77 inches on 23d to 24th; Southport, 1.70 inch on 24th; Salisbury, 1.68 inch on 23d; Weldon, 1.01 on 24th; Winslow, 2.00 inches on 15th, 1.05 inch on 18th; Wilmington, 2.15 inches on 24th.

Local Storms.—St. Thomas-Hatteras, hurricane of September 3d to 12th, caused destructive storms along the North Carolina coast from the 8th to the 12th.

October.

Thunder-storms.—Chattanooga, 22d, 23d; Monroe, 23d, 26th, 27th; Raleigh, 20th; Southport, 26th; Wilmington, 13th, 23d, 26th.

Snow.—Asheville, 14th.

Frosts.—Asheville, 7th, 8th, 9th, 30th; Charlotte, 8th, 9th, 28th,

29th; Chattanooga, 8th, 9th, 10th, 11th, 15th, 28th, 29th; Chapel Hill, 8th, 9th; Clarkton, 8th, 12th, 17th; Clear Creek, 8th, 9th; Franklin, 7th, 8th, 29th, 30th; Highlands, 8th, 9th, 15th, 17th, 18th, 20th, 21st, 22d, 24th, 29th, 30th; Hot Springs, 8th, 9th, 10th; Lenoir, 7th, 8th; Lynchburg, 9th; Morganton, 8th, 9th, 29th, 30th; Mt. Airy, 8th, 9th, 10th, 29th, 30th; Mt. Pleasant, 8th, 9th, 25th, 26th; Monroe, 8th, 9th; Raleigh, 8th, 9th; Salisbury, 8th, 9th, 24th, 25th, 28th, 29th; Weldon, 8th, 9th; Winslow, 8th; Wilmington, 9th.

Solar Halos.—Chattanooga, 16th, 24th; Clarkton, 16th; Lynchburg, 19th.

Rains over one inch.—Chapel Hill, 1.26 inch on 23d, 2.06 inches on 26th; Clear Creek, 1.85 inch on 27th; Hatteras, 2.18 inches on 27th; Lynchburg, 1.60 inch on 13th, 1.55 inch on 27th; Mt. Pleasant, 2.79 inches on 25th to 27th; Monroe, 1.60 inch on 26th; Norfolk, 1.66 inch on 24th, 1.26 inch on 27th, 3.74 inches on 23d; Pittsboro, 2.20 inches on 26th; Raleigh, 1.14 inch on 23d, 1.27 inch on 26th; Southern Pines, 2.50 inches on 26th; Southport, 2.22 inches on 26th; Salisbury, 1.15 inch on 25th to 26th; Weldon, 1.42 inch on 26th to 27th; Wilmington, 1.92 inch on 26th, 1.04 inch on 27th.

Local Storms.—Hatteras, 23d and 24th: High wind caused the tide to rise higher than ever before known at this place. (M. W. R.)*

November.

Thunder-storms.—Hatteras, 18th; Monroe, 21st; Wilmington, 21st.

Snow.—Asheville, 16th, 17th, 18th, 19th, 28th, 29th; Clear Creek, 16th to 17th; Douglas, 21st, 28th; Franklin, 19th, 20th, 28th; Highlands, 18th, 27th, 29th; Hot Springs, 28th; Lenoir, 16th; Mt. Airy, 28th; Mt. Pleasant, 28th.

Hail.—Chattanooga, 16th; Douglas and Winslow, 17th.

Sleet.—Highlands, Mt. Pleasant and Salisbury, 16th.

Frosts.—Asheville, 4th, 6th, 7th, 16th, 17th, 18th, 19th, 20th, 24th; Charlotte, 17th, 19th, 20th; Chattanooga, 6th, 15th, 23d, 24th; Chapel Hill, 7th, 19th, 20th; Clarkton, 7th, 8th, 18th, 19th, 24th, 25th, 28th; Clear Creek, 7th, 10th, 19th, 20th, 23d; Douglas, 5th, 6th, 7th, 8th; Franklin, 4th, 6th, 7th, 10th, 11th, 12th, 15th, 16th, 19th, 20th, 23d, 24th, 25th, 28th; Hatteras, 7th, 24th; Highlands, 4th, 6th, 7th, 12th, 15th, to 20th, 23d, 24th, 25th, 28th; Hot Springs, 4th, 6th, 28th; Kitty Hawk, 30th; Louisburg, 7th; Lenoir, 17th, 19th, 20th, 24th, 28th; Lynchburg, 6th, 7th, 16th, 24th; Morganton, 4th, 7th, 16th, 17th, 19th, 20th, 24th; Mt. Airy, 6th, 7th, 16th, 17th, 19th, 20th, 21st, 24th, 28th; Mt. Pleasant, 7th, 10th, 19th, 20th, 23d, 24th; Monroe, 7th, 19th, 23d, 24th; Norfolk, 5th, 7th; Raleigh, 7th, 16th, 19th, 20th; Southport; Salisbury, 19th, 20th; Weldon, 7th, 24th; Winslow; Wilmington, 19th, 20th, 24th; Pittsboro, 19th, 20th, 24th. Heavy frost over the entire State on the 29th and 30th.

Solar Holas.—Raleigh, 2d; Winslow, 7th.

Lunar Halos.—Chattanooga, 6th; Clarkton, 1st; Lynchburg, 5th, 7th; Mt. Pleasant, 7th; Pittsboro, 7th, 19th, 20th, 24th, 29th, 30th; Raleigh, 1st, 7th; Southport, 1st, 2d, 8th, 10th, 16th; Weldon, 1st.

Rains over one inch.—Asheville, 1.07 inch on 17th; Charlotte, 1.90 inch on 17th, 1.02 inch on 21st; Chattanooga, 1.36 inch on 8th, 1.40 inch on 17th; Chapel Hill, 1.85 inch on 17th; Clarkton, 2.40 inches on 17th; Clear Creek, 2.90 inches on 17th, 1.30 inch on 21st; Douglas, 1.50 inch on 17th to 18th; Franklin, 1.30 inch on 13th; Hatteras, 1.12 inch on 18th, 1.56 inch on 28th; Highlands, 1.95 inch on 9th, 1.90 inch on 17th; Kitty Hawk, 2.02 inches on 28th; Louisburg, 1.30 inch on 21st; Lenoir, 1.20 inch on 8th to 9th, 3.00 inches on 16th to 17th; Lynchburg, 1.60 inch on 13th; Morganton, 2.25 inches on 13th, 3.30 inches on 16th to 18th; Mt. Airy, 1.12 inch on 17th; Mt. Pleasant, 3.05 inches on 16th to 17th, 1.31 inch on 21st; Monroe, 2.10 inches on 20th to 21st; Norfolk, 0.20 inch in eight minutes on 21st; Pittsboro, 1.20 inch on 17th, 1.70 inch on 21st; Raleigh, 1.10 inch on 21st; Salisbury, 1.83 inch on 17th; Wilmington, 1.02 inch on 17th.

Local Storms.—Press reports state that a destructive storm, moving from southwest, passed over Newbern at 1 p. m. on the 21st, causing loss of life and considerable damage to property; and that on the 28th a destructive storm passed over the northern part of Beaufort County.

December.

Thunder storms.—Washington, 18th.

Snow.—Traces at Mt. Airy, on 30th; Washington, 30th, 31st.

Hail.—Washington, 16th.

Sleet.—Washington, 30th, 31st.

Frosts.—Frosts occurred over the entire State on the 1st and 2d, also at Chapel Hill, 5th, 16th; Clear Creek, 3d, 4th, 5th, 12th, 13th; Douglas, 3d, 5th, 13th, 14th, 15th, 20th, 24th, 25th, 26th, 31st; Franklin, 3d, 4th, 12th, 13th, 14th, 15th, 16th, 23d, 24th; Hatteras, 13th; Highlands, 5th, 13th, 14th, 15th; Hot Springs, 3d, 12th, 13th; Lenoir, 3d, 12th, 13th, 24th; Lynchburg, 5th, 7th, 16th, 24th, 31st; Morganton, 4th, 12th, 13th, 31st; Mt. Pleasant, 3d, 12th, 13th, 16th, 24th; Norfolk, 5th; Pittsboro, 3d, 5th, 16th; Raleigh, 5th, 16th, 24th; Salisbury, 3d, 12th, 16th, 24th; Weldon, 13th, 16th, 24th; Washington, 4th, 7th, 9th, 16th, 24th; Wilmington, 5th.

Solar Halos.—Chattanooga, 15th; Hatteras, 9th, 16th, 26th, 30th; Raleigh, 9th, 10th; Southport, 3d.

Lunar Halos.—Charlotte, 27th, 28th Chattanooga, 7th; Hatteras, 27th, 29th; Lenoir, 27th; Lynchburg, 24th, 27th, 28th, 29th; Mt. Airy, 26th, 28th; Mt. Pleasant, 5th, 7th, 29th; Raleigh, 5th, 29th; Southport, 6th, 27th, 29th, 30th; Weldon, 29th; Washington, 26th, 27th; Wilmington, 5th, 10th, 27th, 29th; Corona, 27th.

Meteors.—Washington, 12th, 15th, 27th; Raleigh, 19th.

No rains over one inch during the month. No local storms reported.

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